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Cho et al.

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(45) Date of Patent: Dec. 17, 2024

(54) ELECTRONIC DEVICE INCLUDING FLEXIBLE DISPLAY, AND DISPLAY METHOD USING SAME

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(73) Assignee: **SAMSUNG ELECTRONICS CO., LTD.**, Suwon-si (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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Related U.S. Application Data

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(30) **Foreign Application Priority Data**

Nov. 13, 2020 (KR) 10-2020-0152303
Mar. 8, 2021 (KR) 10-2021-0029936

(51) **Int. Cl.**

G06F 3/041 (2006.01)
G06F 1/16 (2006.01)
G06F 3/044 (2006.01)

(52) **U.S. Cl.**

CPC ***G06F 3/04166*** (2019.05); ***G06F 1/1652*** (2013.01); ***G06F 3/0412*** (2013.01); ***G06F 3/044*** (2013.01); *G06F 2203/04102* (2013.01)

(58) **Field of Classification Search**

CPC .. G06F 3/04166; G06F 1/1652; G06F 3/0412; G06F 3/044; G06F 2203/04102;

(Continued)

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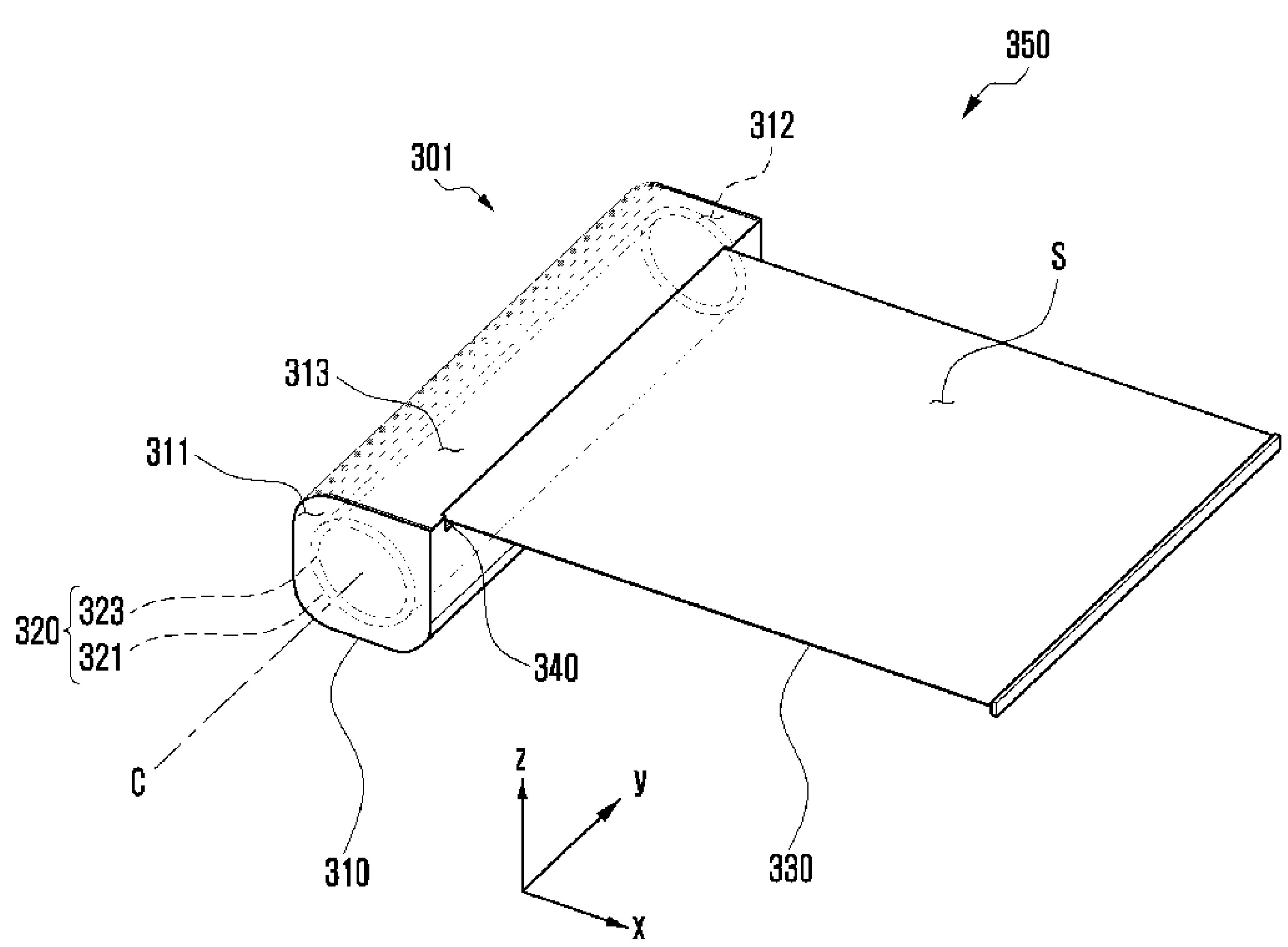
(Continued)

Primary Examiner — William Lu
(74) *Attorney, Agent, or Firm* — Sughrue Mion, PLLC

(57) **ABSTRACT**

According to various embodiments of the present disclosure, an electronic device includes: a housing; a touch circuit including a plurality of TX electrodes, and a plurality of RX electrodes arranged to cross over the plurality of TX electrode; a flexible display which includes the touch circuit, and which can be withdrawn from the inner space of the housing; a touch controller; and a processor operatively connected to the touch circuit, the flexible display and the touch controller, wherein the touch controller applies a driving signal by using the plurality of TX electrodes of the touch circuit, acquires the driving signal by using the plurality of RX electrodes, confirms a capacitance value on the basis of the acquired driving signal, and confirms information about a folded area of the flexible display on the basis of the

(Continued)



capacitance value, and the processor can set an activation area for an unfolded area of the flexible display on the basis of the folded area of the flexible display. Various embodiments, in addition to various embodiments disclosed in the present document, are also possible.

14 Claims, 36 Drawing Sheets

(58) **Field of Classification Search**
CPC G06F 3/017; G06F 1/3228; G06F 1/3234; G09F 9/301
See application file for complete search history.

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Communication issued on Jan. 3, 2024 by the European Patent Office for European Patent Application No. 21892184.9.

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FIG. 1

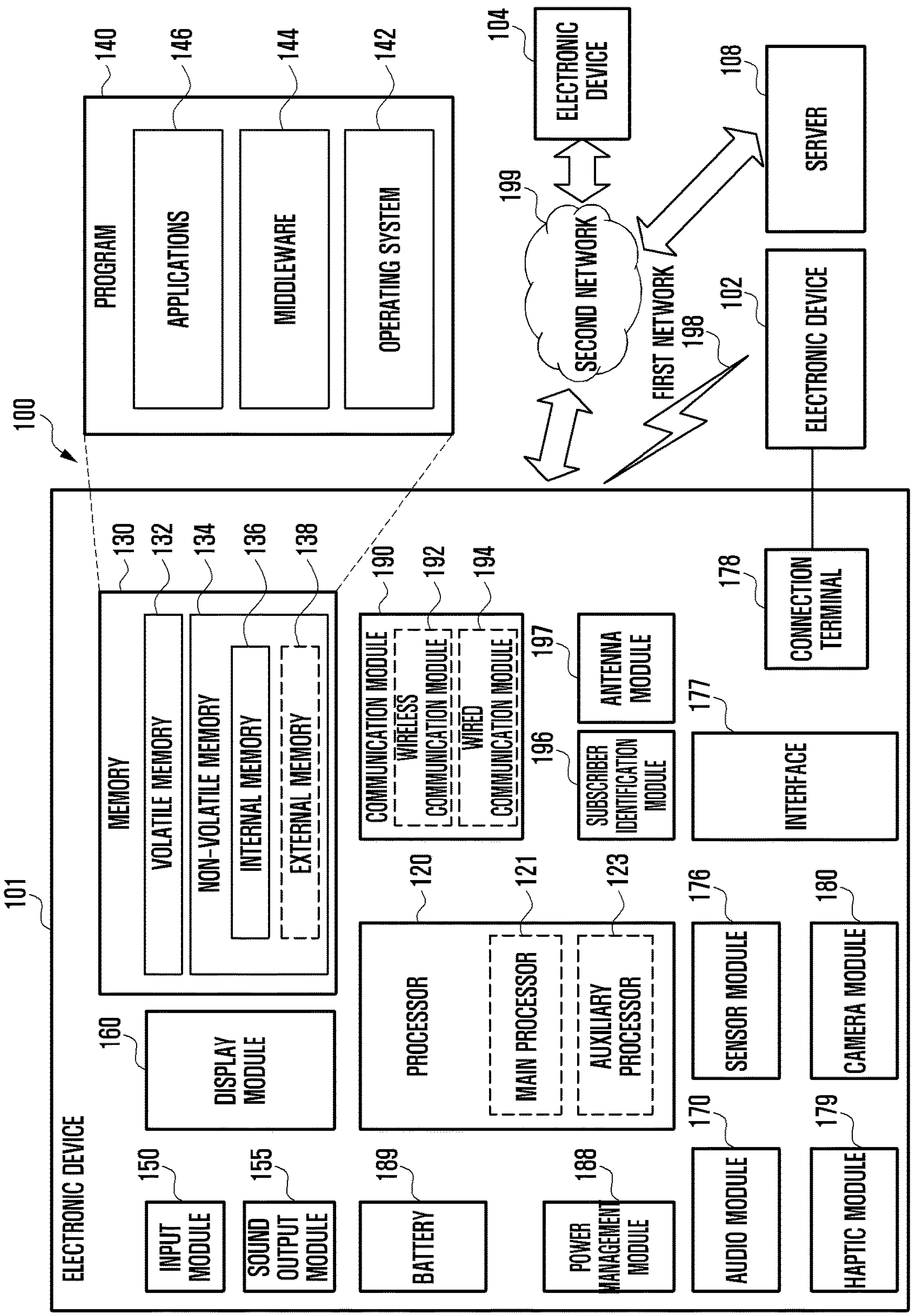

100
101
ELECTRONIC DEVICE
INPUT MODULE
150
SOUND OUTPUT MODULE
155
BATTERY
189
POWER MANAGEMENT MODULE
188
AUDIO MODULE
170
HAPTIC MODULE
179
DISPLAY MODULE
160
PROCESSOR
120
MAIN PROCESSOR
121
AUXILIARY PROCESSOR
123
SENSOR MODULE
176
CAMERA MODULE
180
MEMORY
130
VOLATILE MEMORY
132
NON-VOLATILE MEMORY
134
INTERNAL MEMORY
136
EXTERNAL MEMORY
138
COMMUNICATION MODULE
190
WIRELESS COMMUNICATION MODULE
192
WIRED COMMUNICATION MODULE
194
SUBSCRIBER IDENTIFICATION MODULE
196
ANTENNA MODULE
197
INTERFACE
177
CONNECTION TERMINAL
178
PROGRAM
140
APPLICATIONS
146
MIDDLEWARE
144
OPERATING SYSTEM
142
SECOND NETWORK
199
FIRST NETWORK
198
ELECTRONIC DEVICE
104
SERVER
108
ELECTRONIC DEVICE
102

FIG. 2

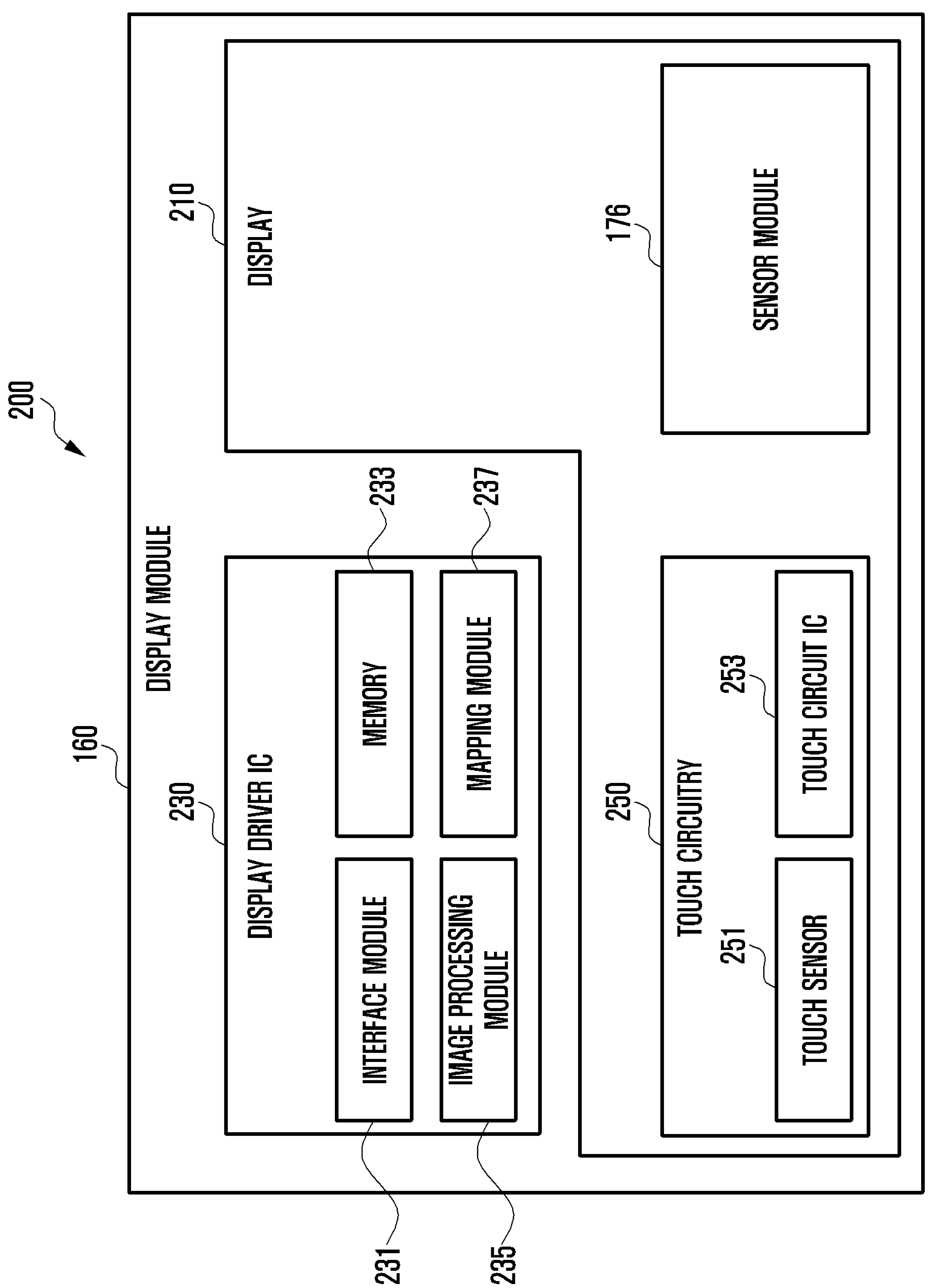

200
160
DISPLAY MODULE
210
DISPLAY
176
SENSOR MODULE
230
DISPLAY DRIVER IC
233
MEMORY
237
MAPPING MODULE
INTERFACE MODULE
IMAGE PROCESSING MODULE
231
235
250
TOUCH CIRCUITRY
251
TOUCH SENSOR
253
TOUCH CIRCUIT IC

FIG. 3A

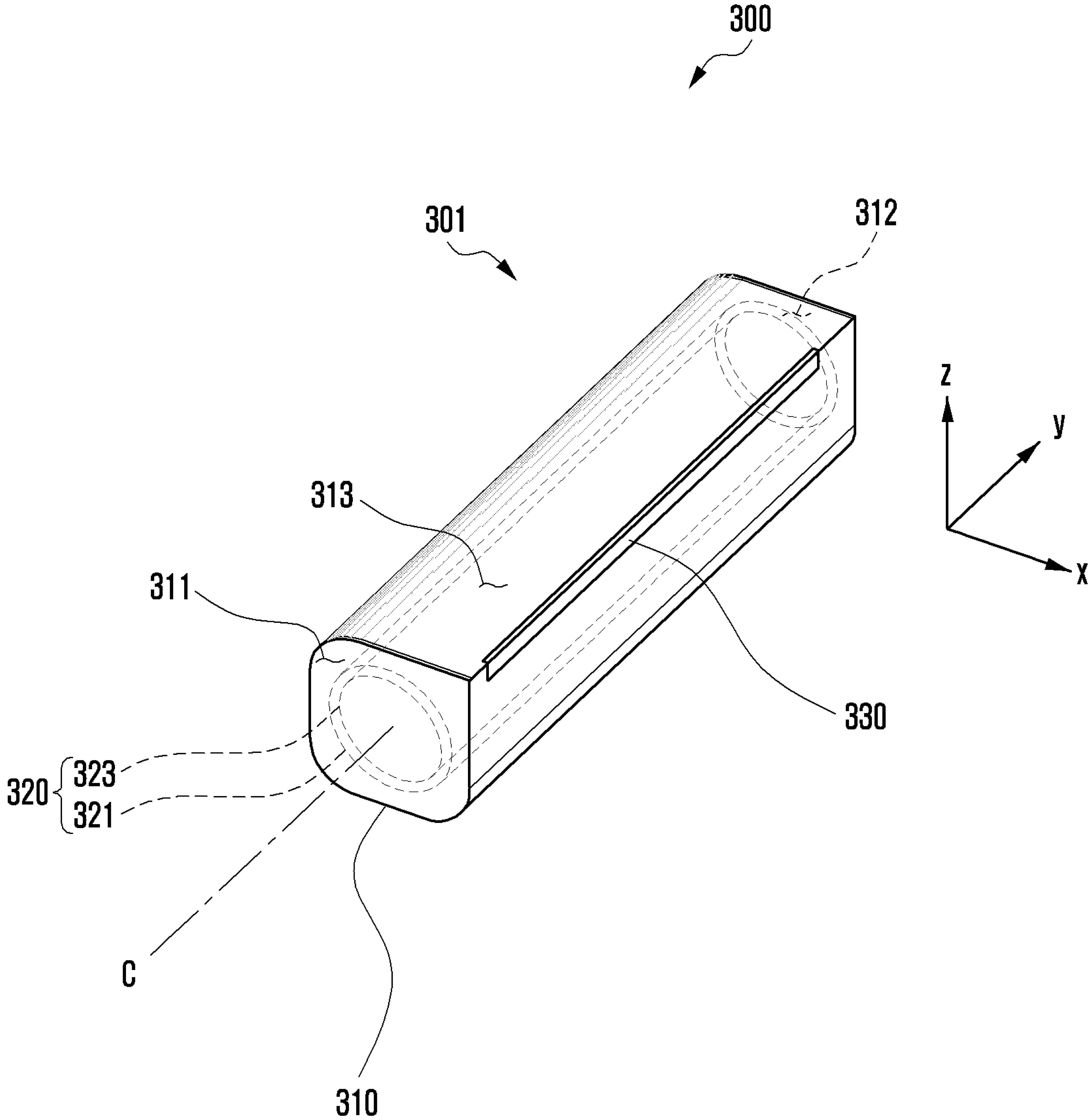


FIG. 3B

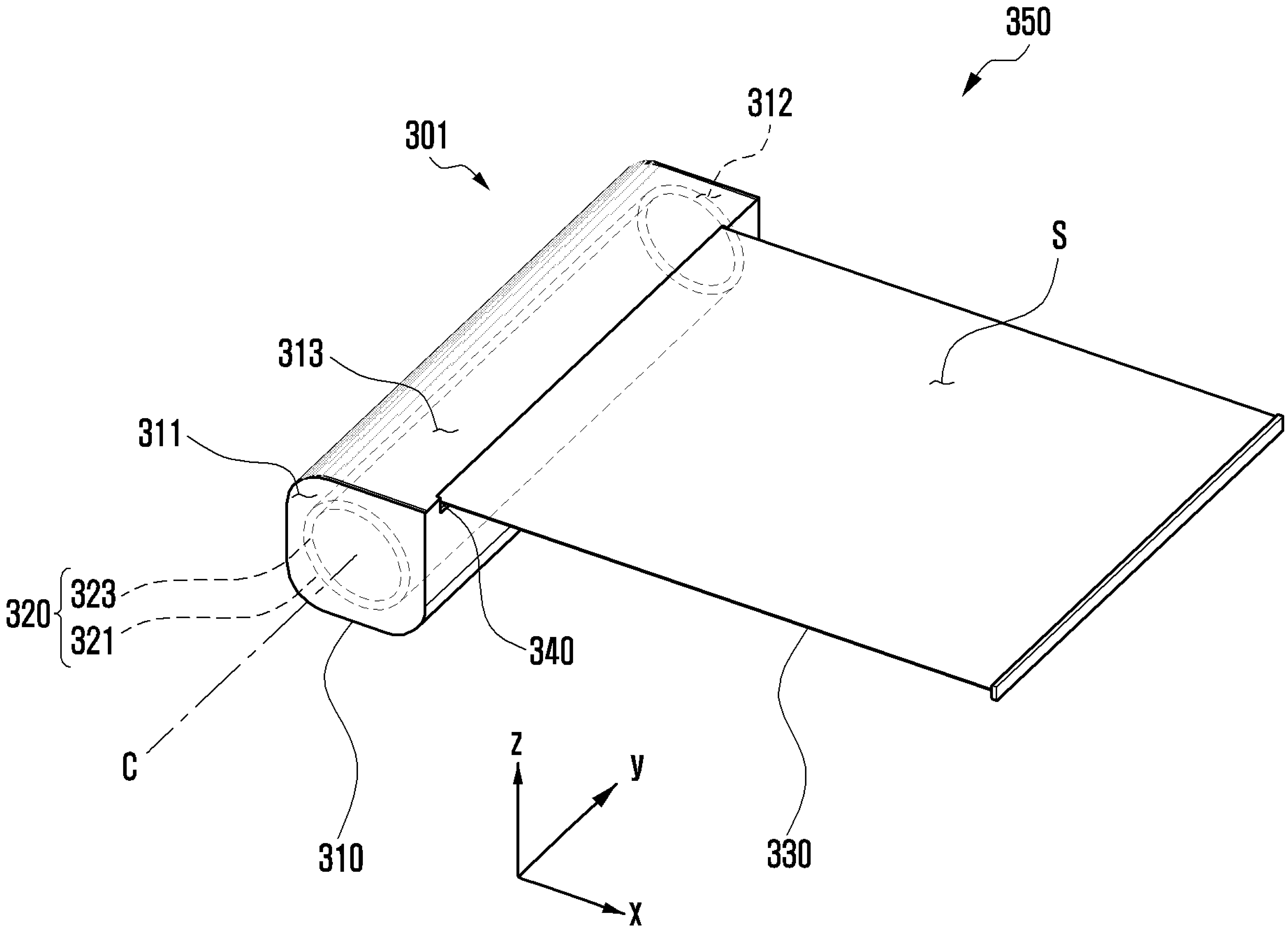


FIG. 4A

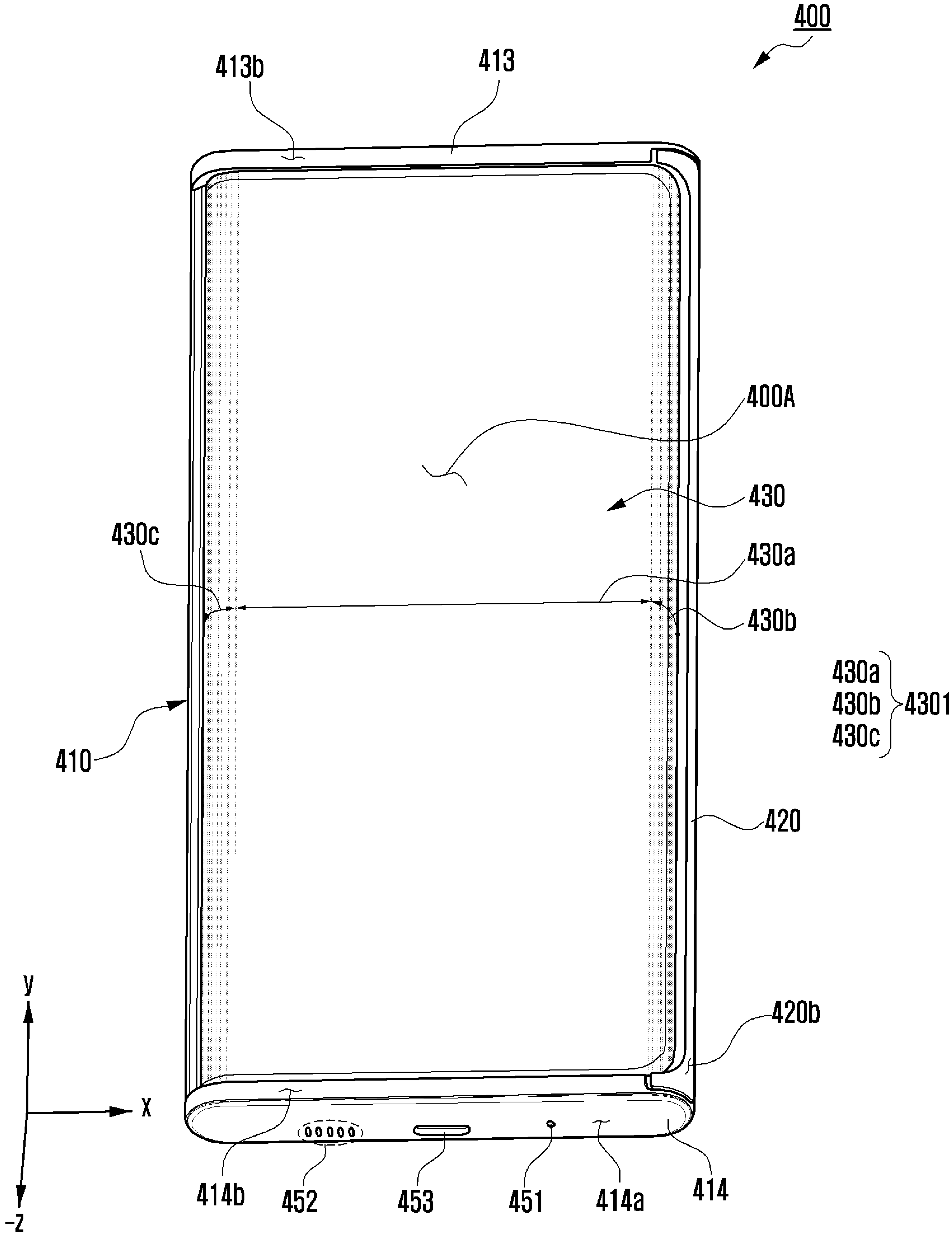

400
413b
413
400A
430
430c
430a
430b
430a
430b
430c
4301
410
420
420b
y
x
-z
414b
452
453
451
414a
414

FIG. 4B

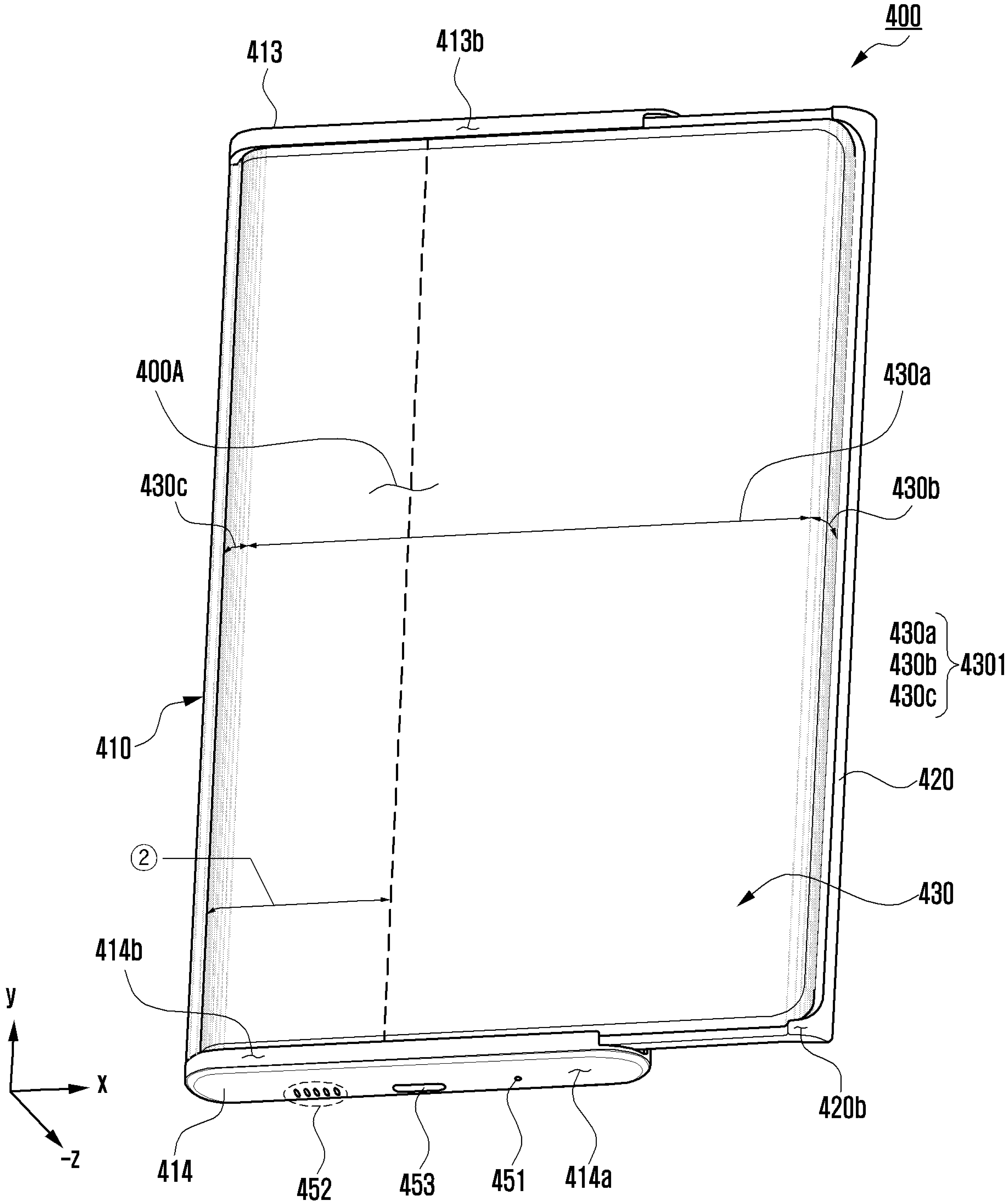

400
413
413b
400A
430a
430c
430b
430a
430b
430c
4301
410
420
②
430
414b
y
x
-z
414
452
453
451
414a
420b

FIG. 5A

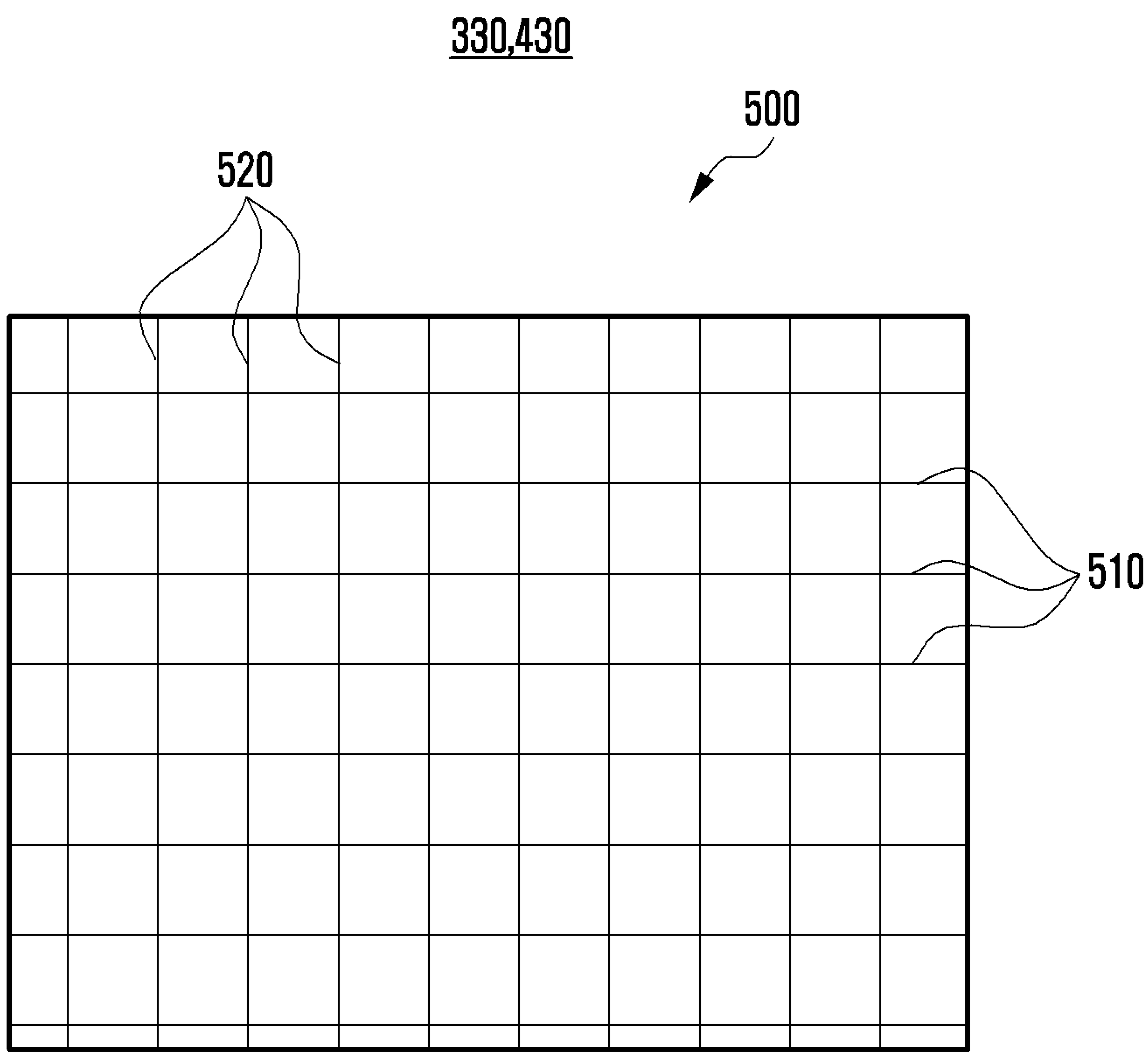


FIG. 5B

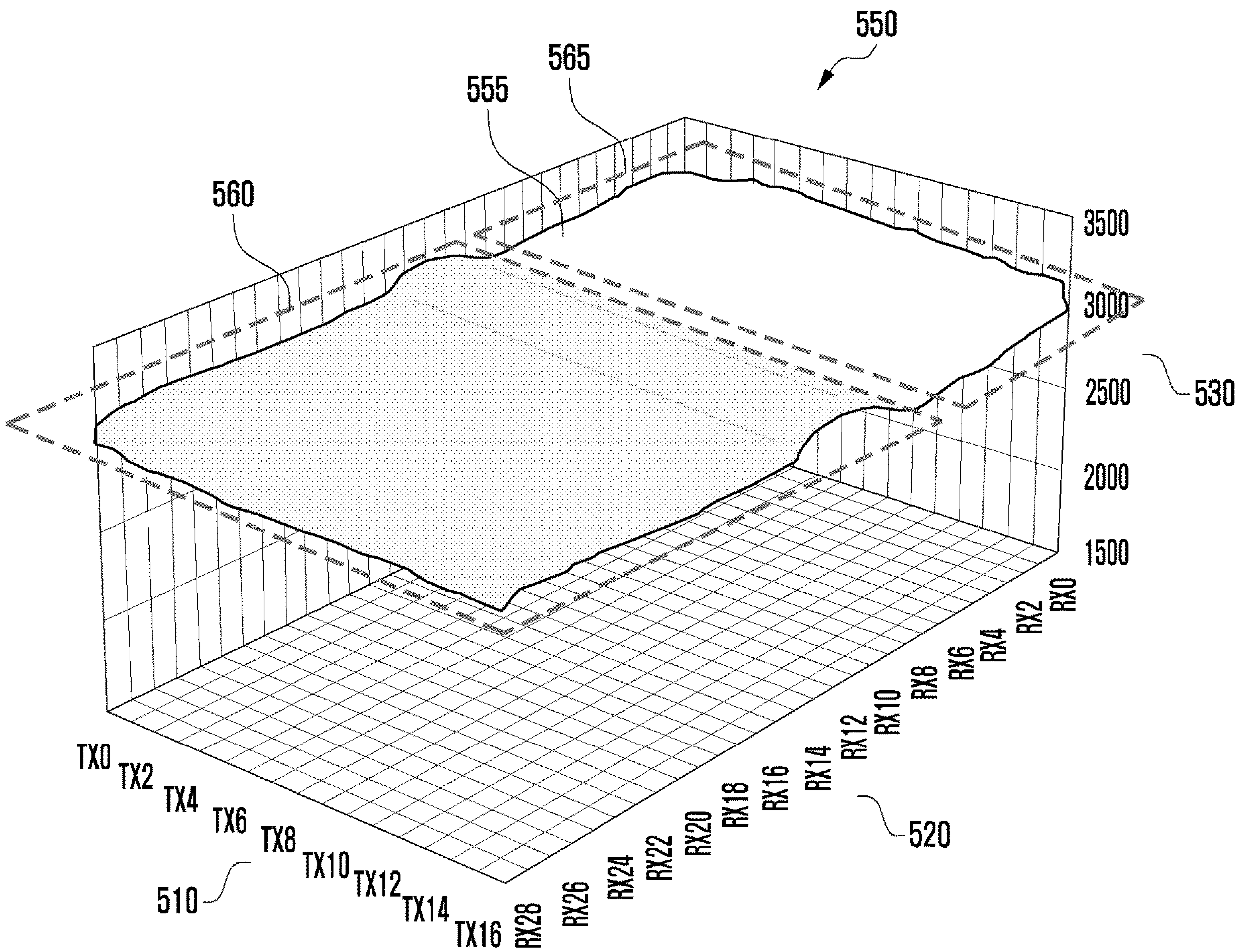

550
565
555
560
3500
3000
2500
2000
1500
530
RX0
RX2
RX4
RX6
RX8
RX10
RX12
RX14
RX16
RX18
RX20
RX22
RX24
RX26
RX28
520
TX0
TX2
TX4
TX6
TX8
TX10
TX12
TX14
TX16
510

FIG. 5C

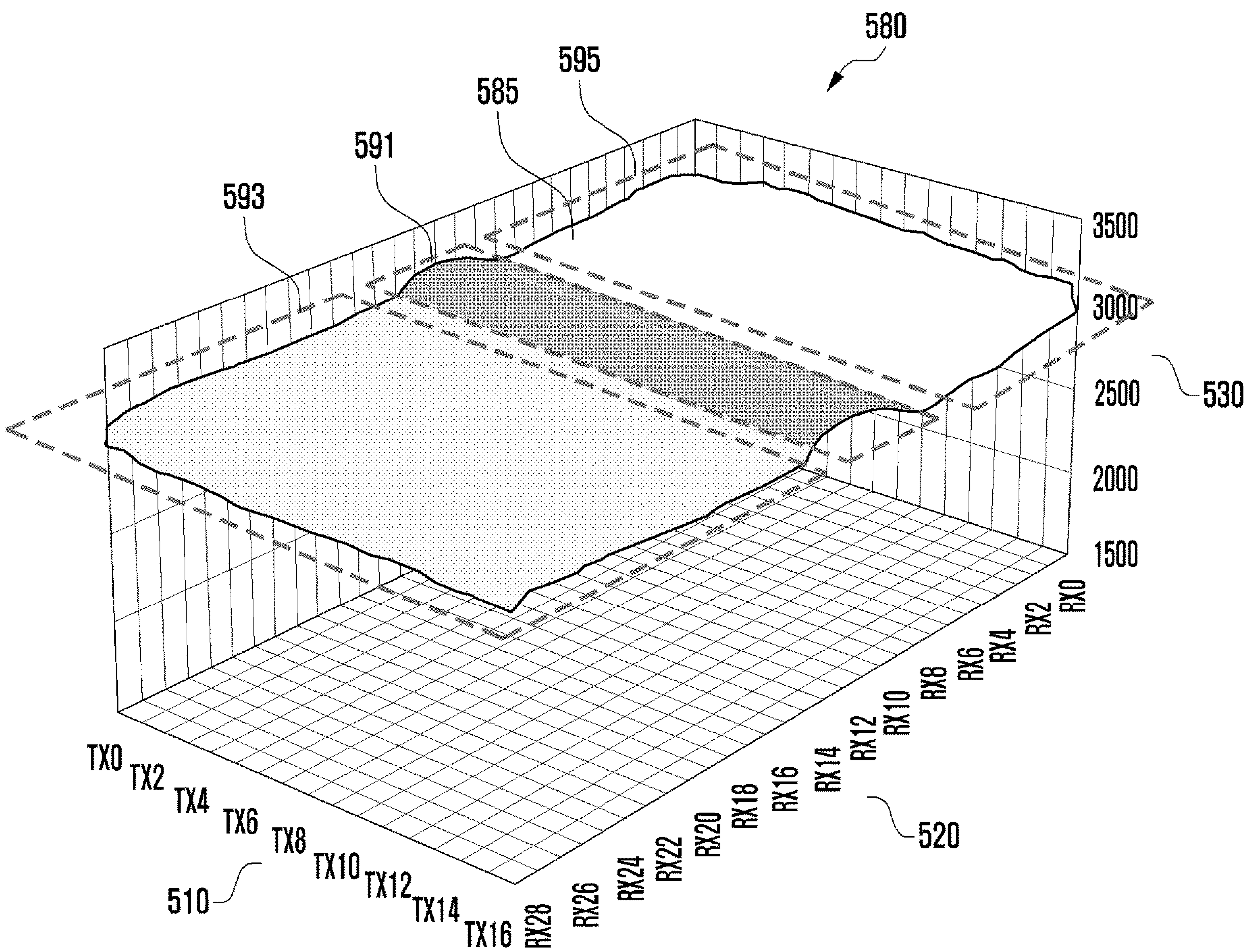

580
595
585
591
593
3500
3000
2500
2000
1500
530
RX0
RX2
RX4
RX6
RX8
RX10
RX12
RX14
RX16
RX18
RX20
RX22
RX24
RX26
RX28
520
TX0
TX2
TX4
TX6
TX8
TX10
TX12
TX14
TX16
510

FIG. 6A

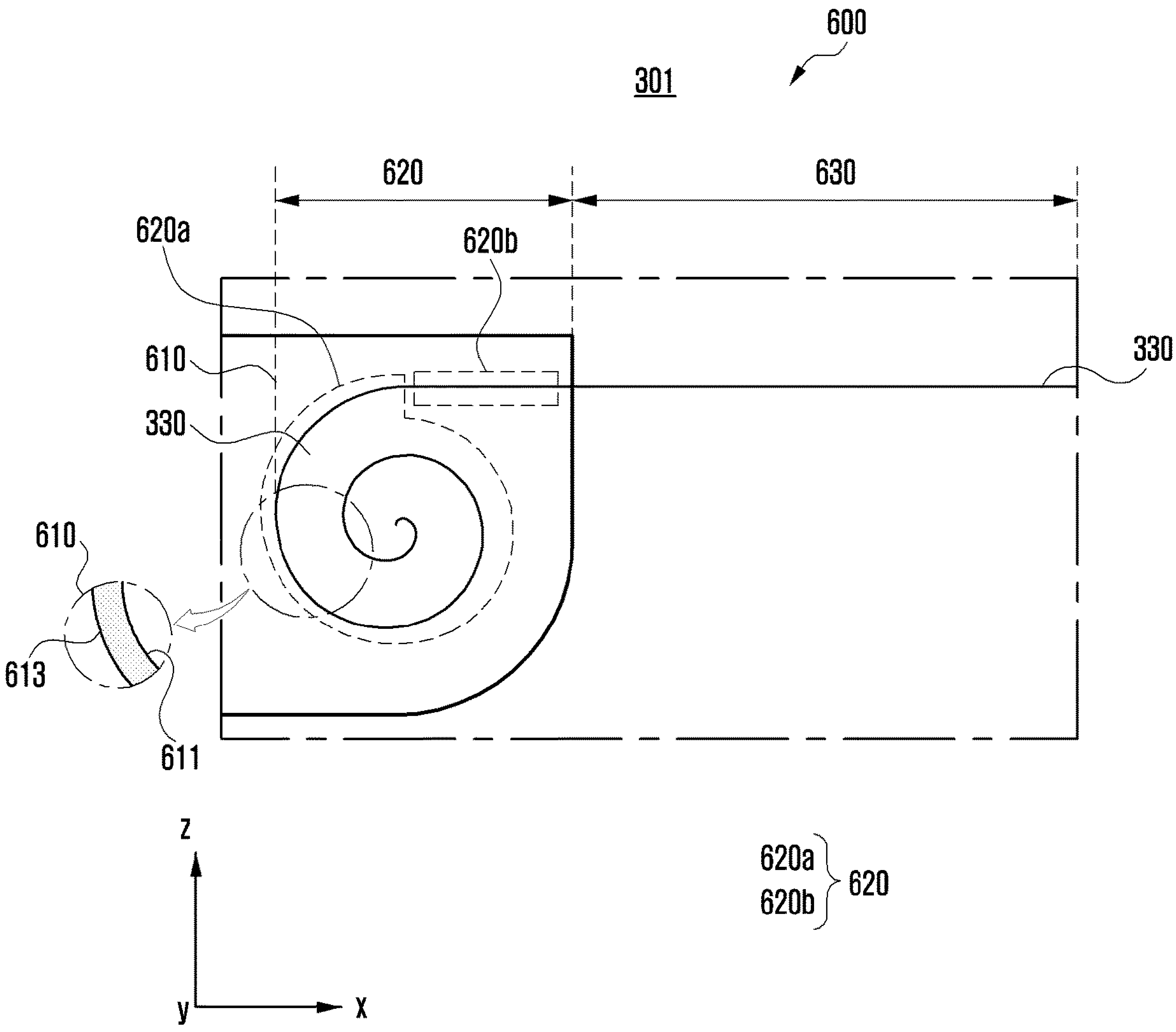

600
301
620
630
620a
620b
610
330
330
610
613
611
z
y
x
620a
620b
620

FIG. 6B

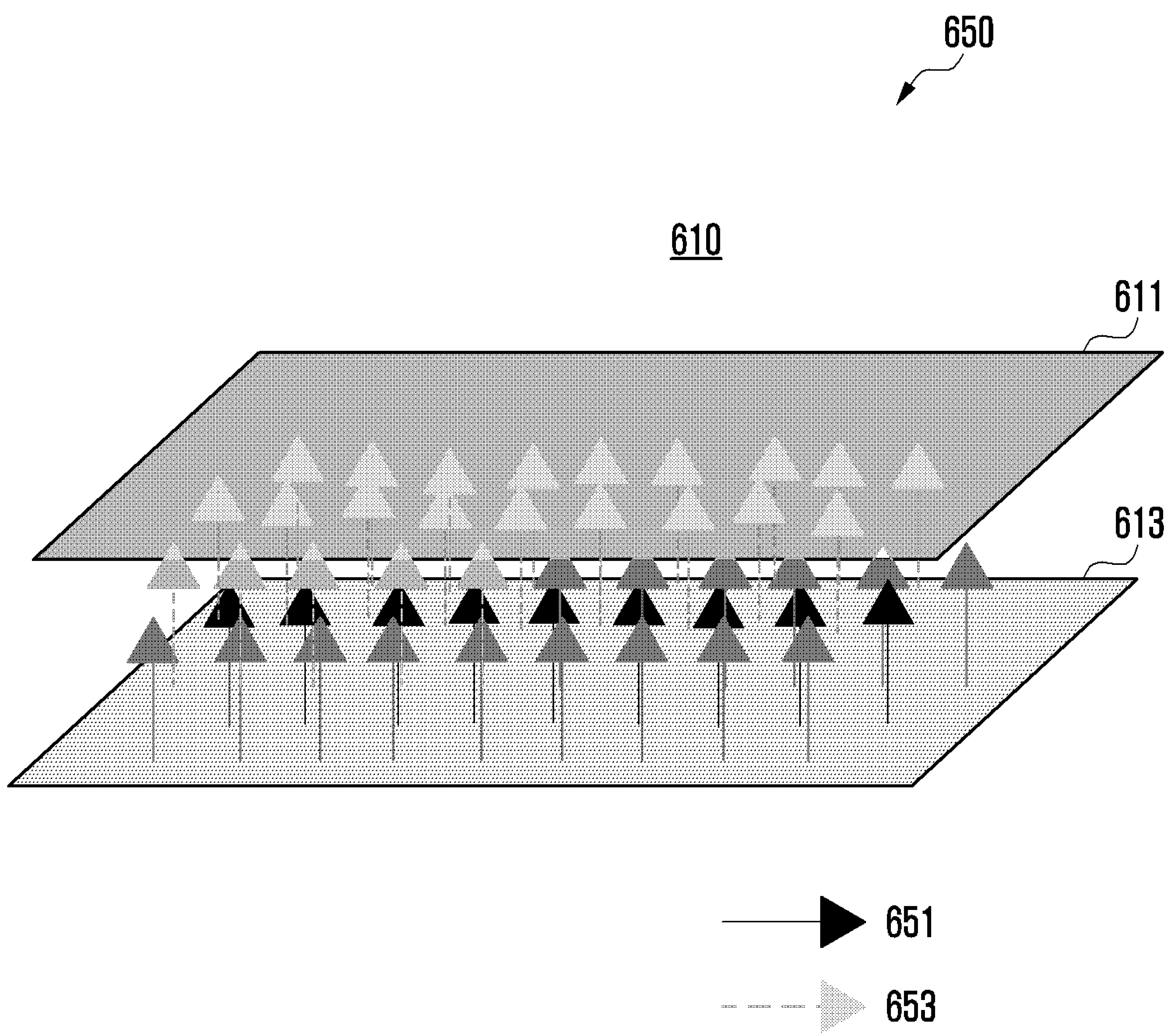


FIG. 7

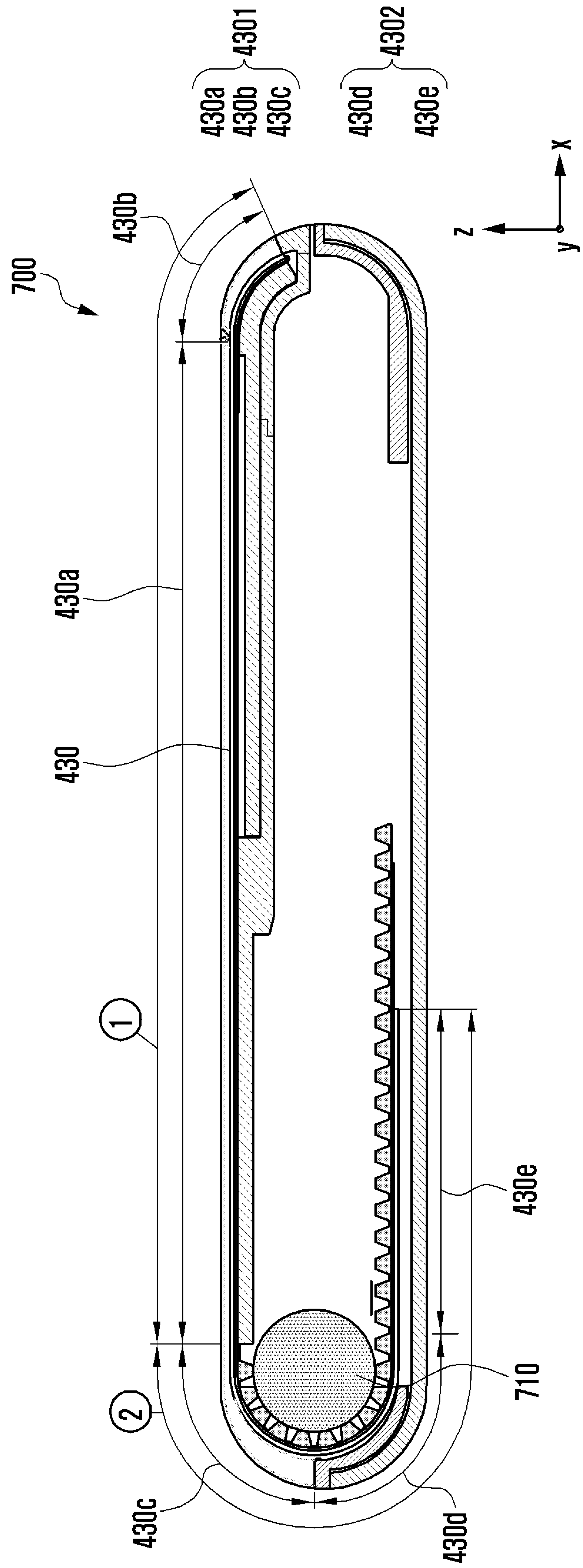

4301
4302
430a
430b
430c
430d
430e
x
z
y
700
430b
430a
430
1
2
430c
430d
430e
710

FIG. 8

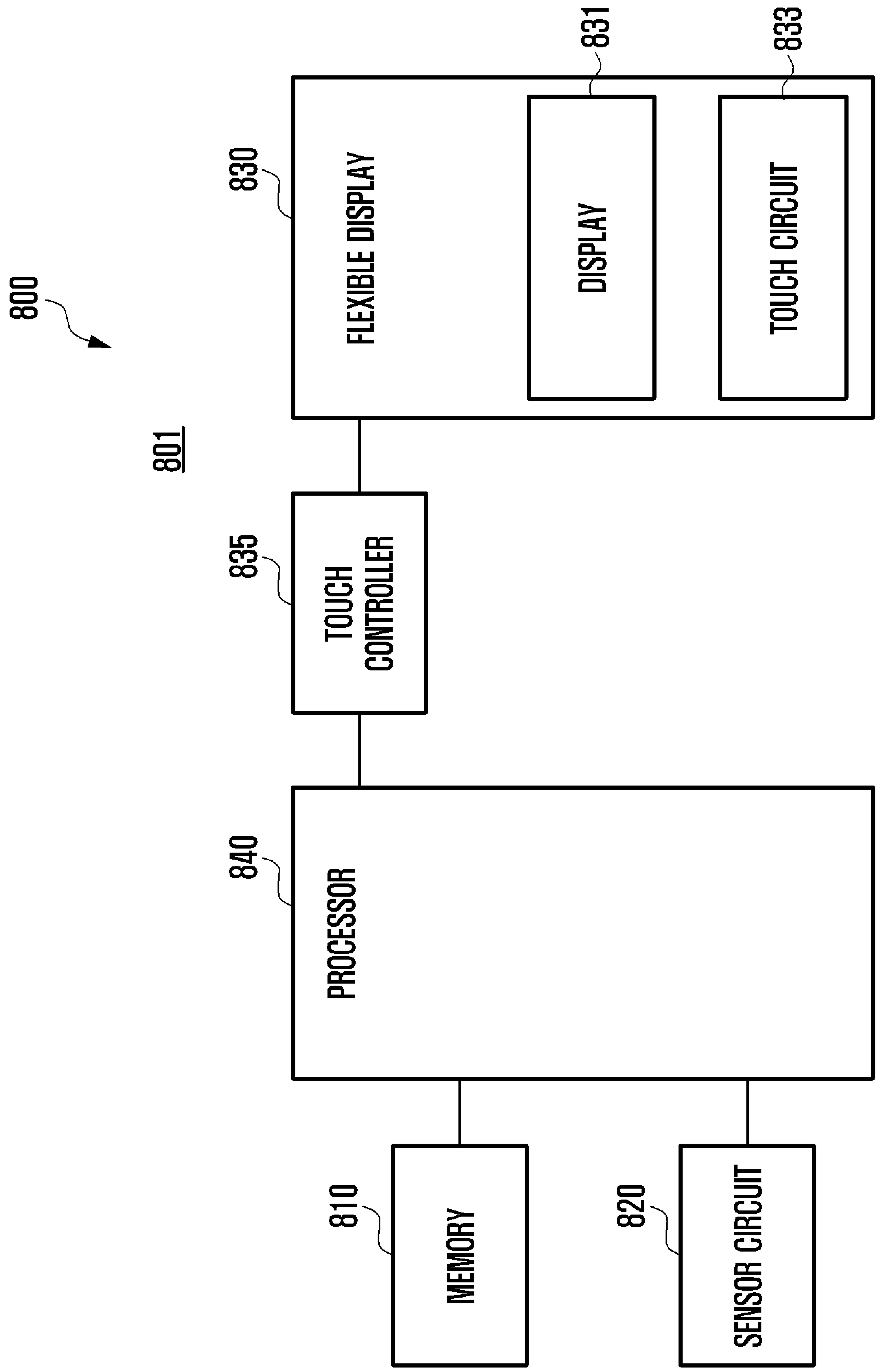

800
801
830
FLEXIBLE DISPLAY
831
DISPLAY
833
TOUCH CIRCUIT
835
TOUCH CONTROLLER
840
PROCESSOR
810
MEMORY
820
SENSOR CIRCUIT

FIG. 9

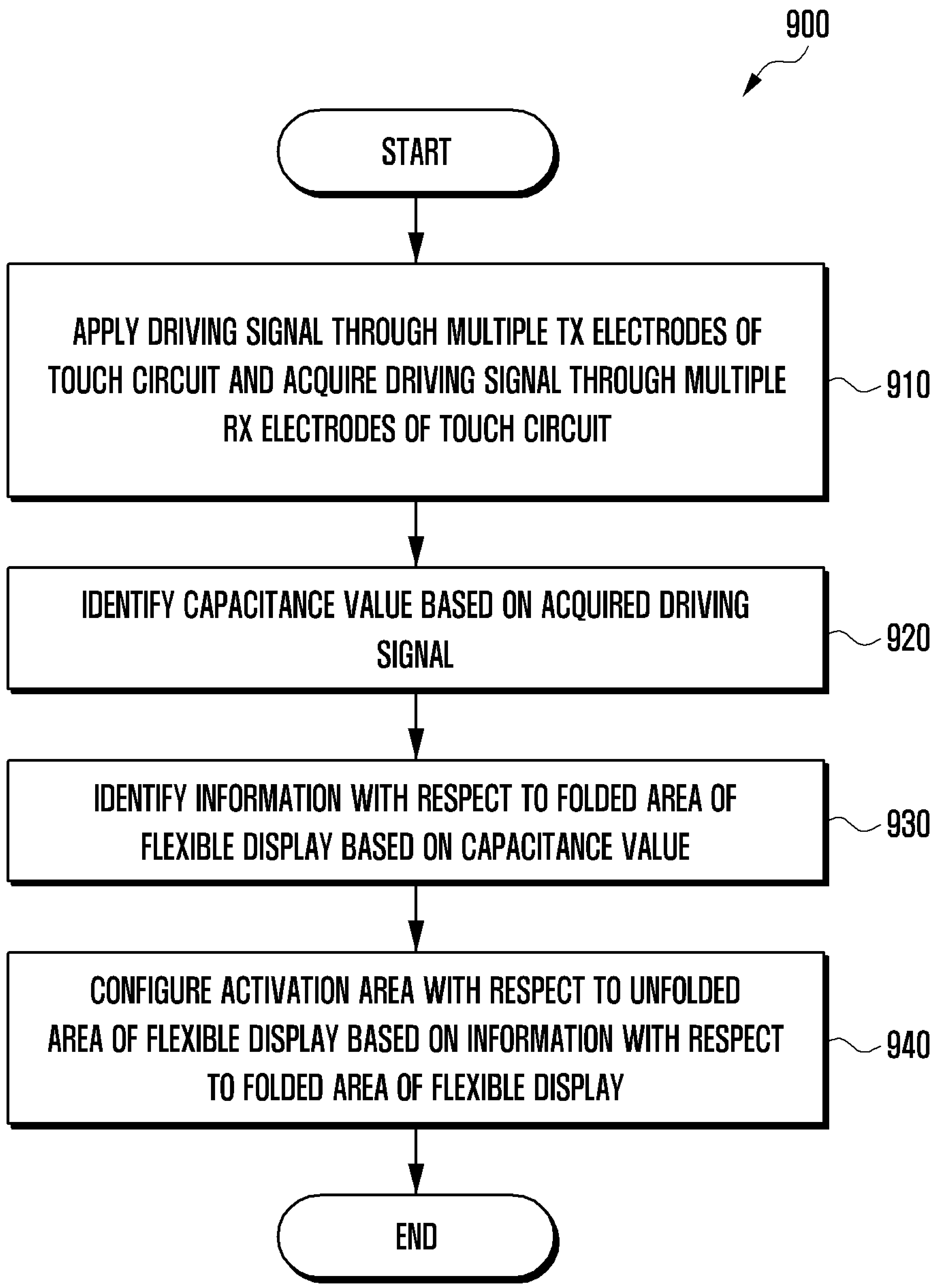

900
START
APPLY DRIVING SIGNAL THROUGH MULTIPLE TX ELECTRODES OF TOUCH CIRCUIT AND ACQUIRE DRIVING SIGNAL THROUGH MULTIPLE RX ELECTRODES OF TOUCH CIRCUIT
910
IDENTIFY CAPACITANCE VALUE BASED ON ACQUIRED DRIVING SIGNAL
920
IDENTIFY INFORMATION WITH RESPECT TO FOLDED AREA OF FLEXIBLE DISPLAY BASED ON CAPACITANCE VALUE
930
CONFIGURE ACTIVATION AREA WITH RESPECT TO UNFOLDED AREA OF FLEXIBLE DISPLAY BASED ON INFORMATION WITH RESPECT TO FOLDED AREA OF FLEXIBLE DISPLAY
940
END

FIG. 10A

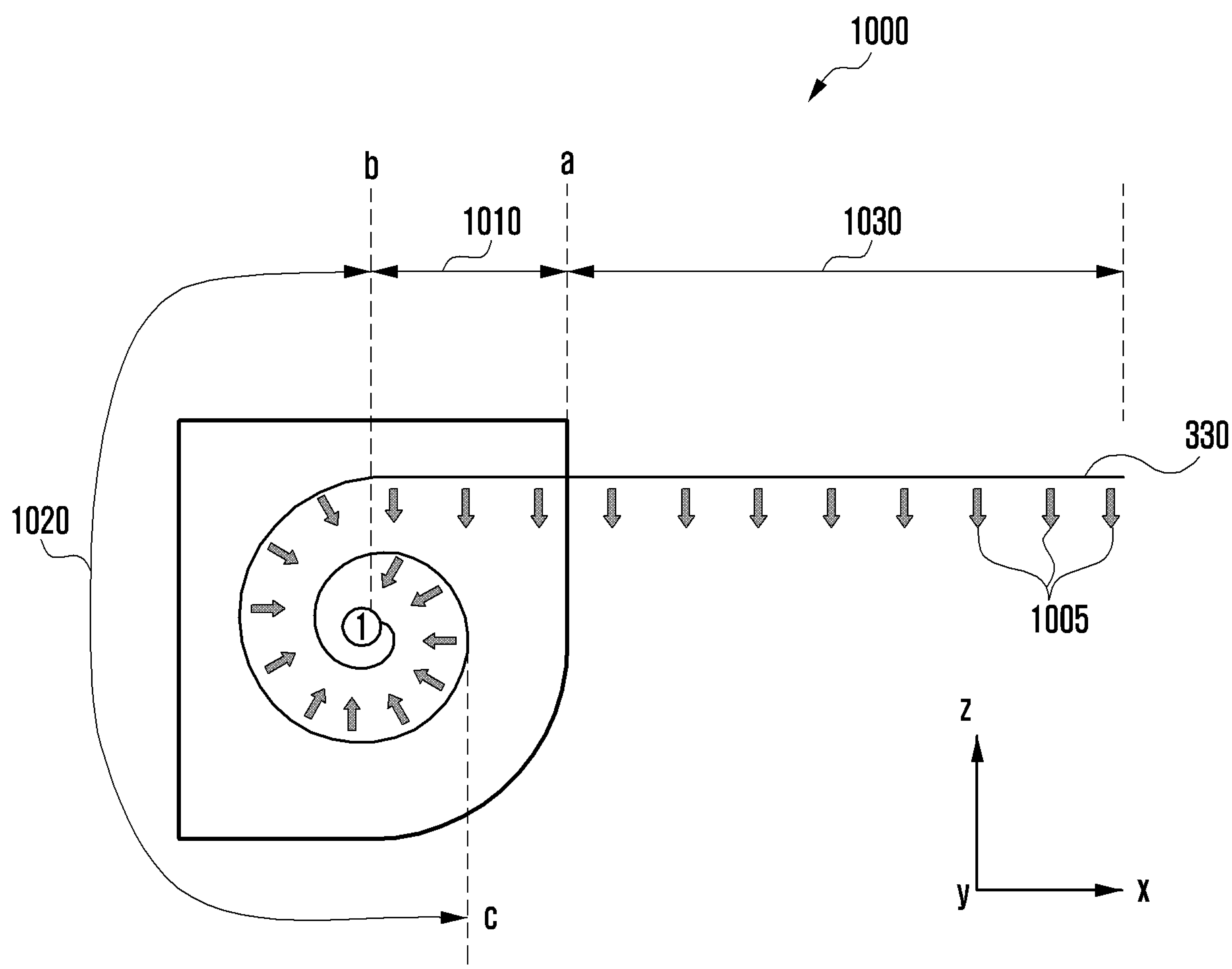


FIG. 10B

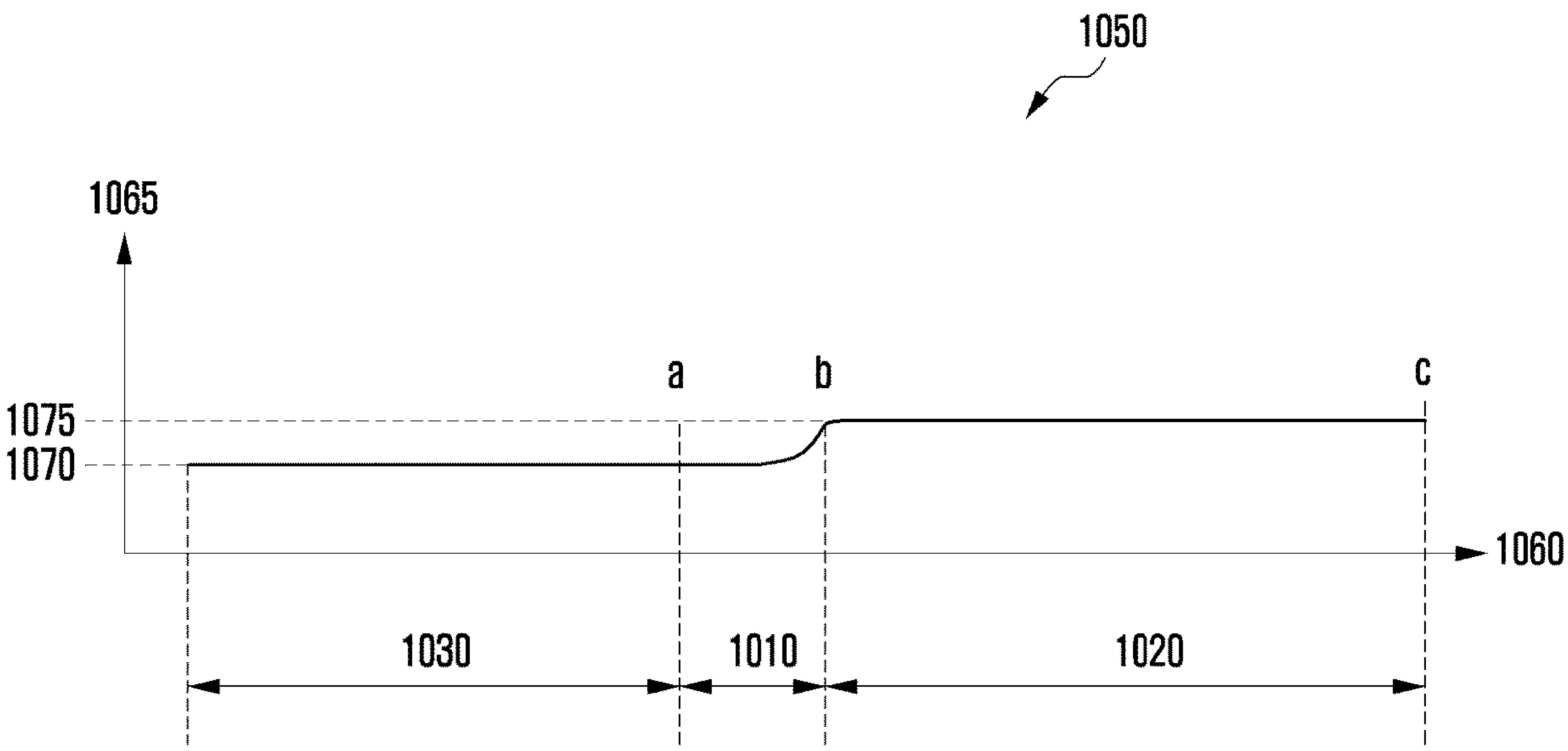


FIG. 11A

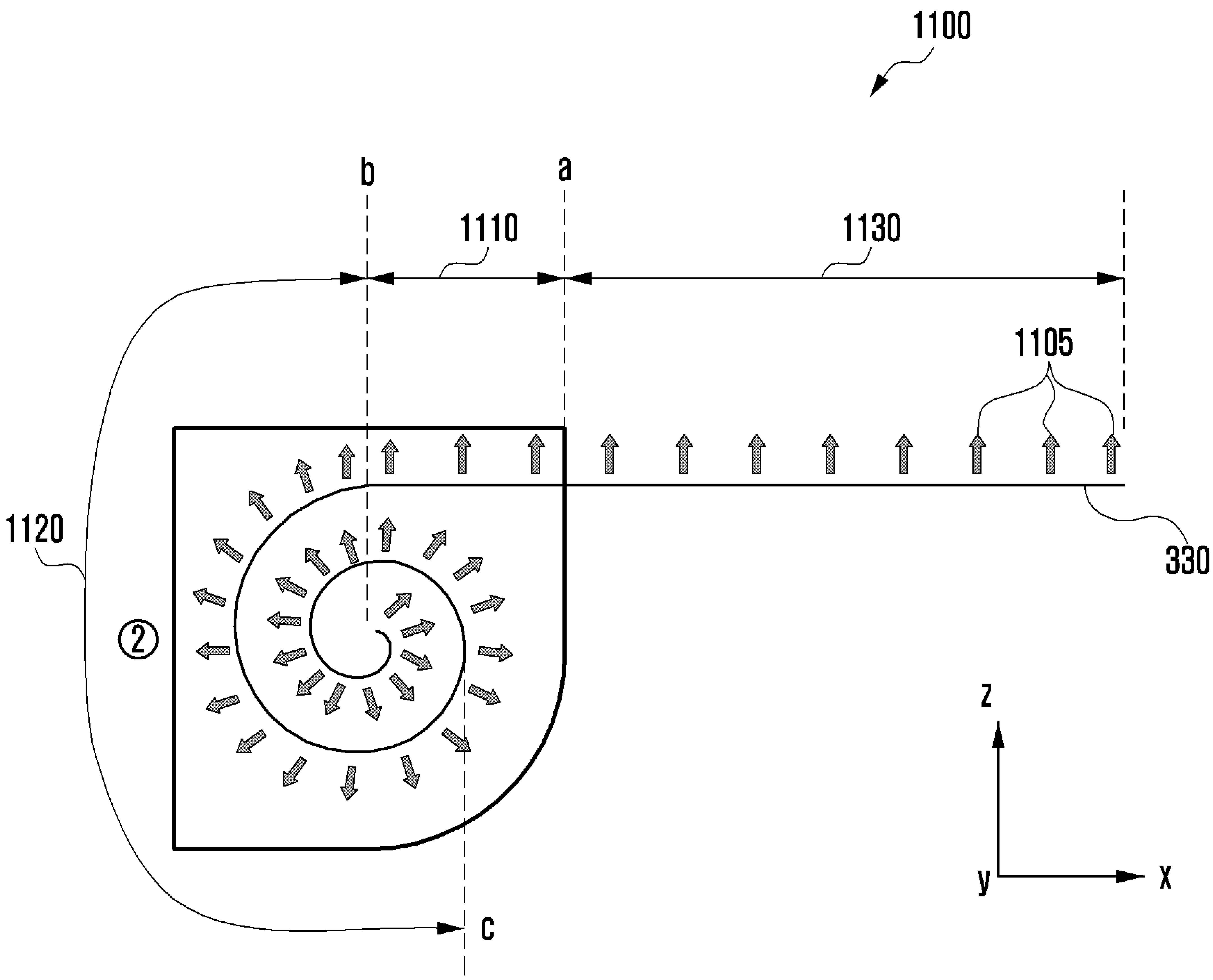


FIG. 11B

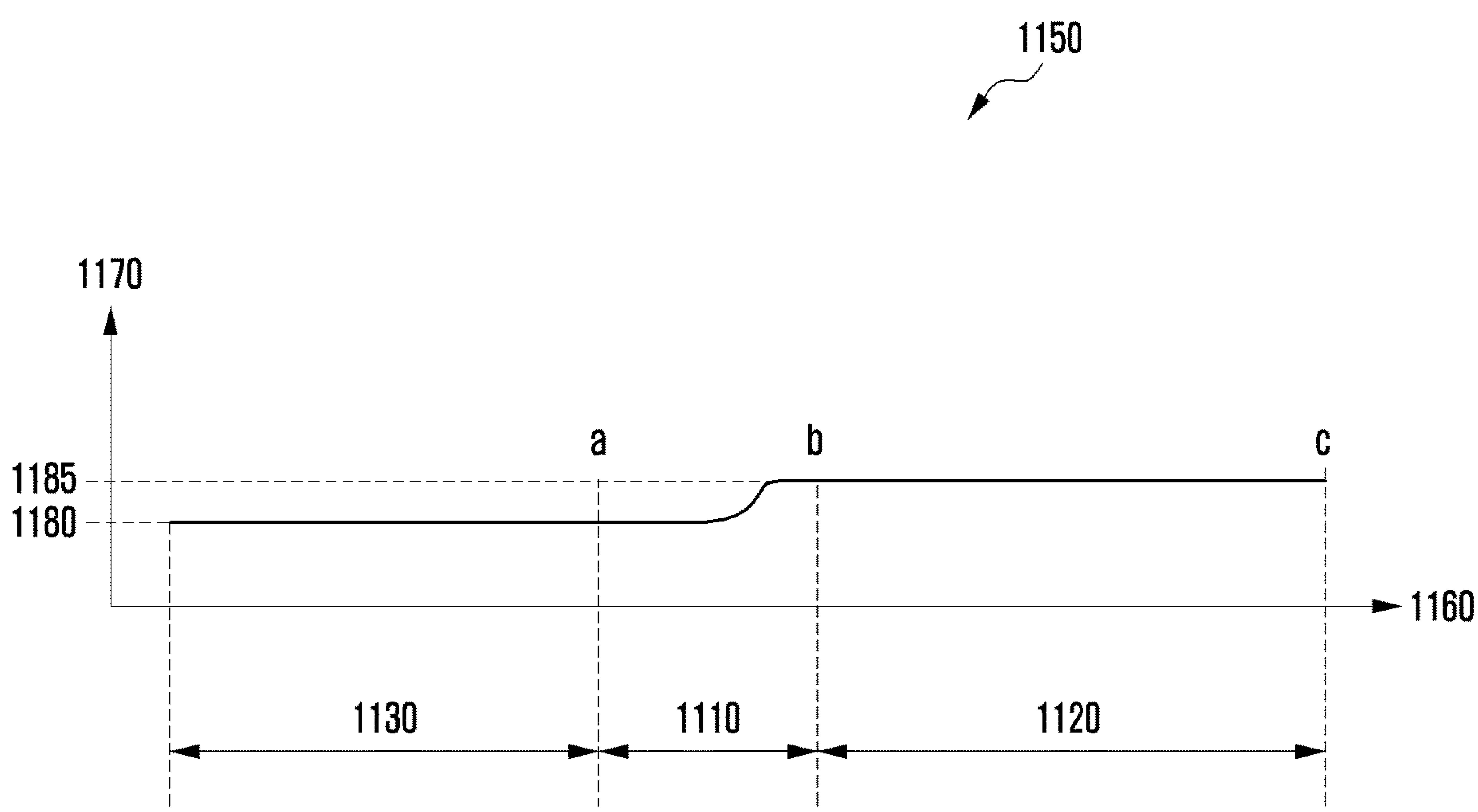


FIG. 12A

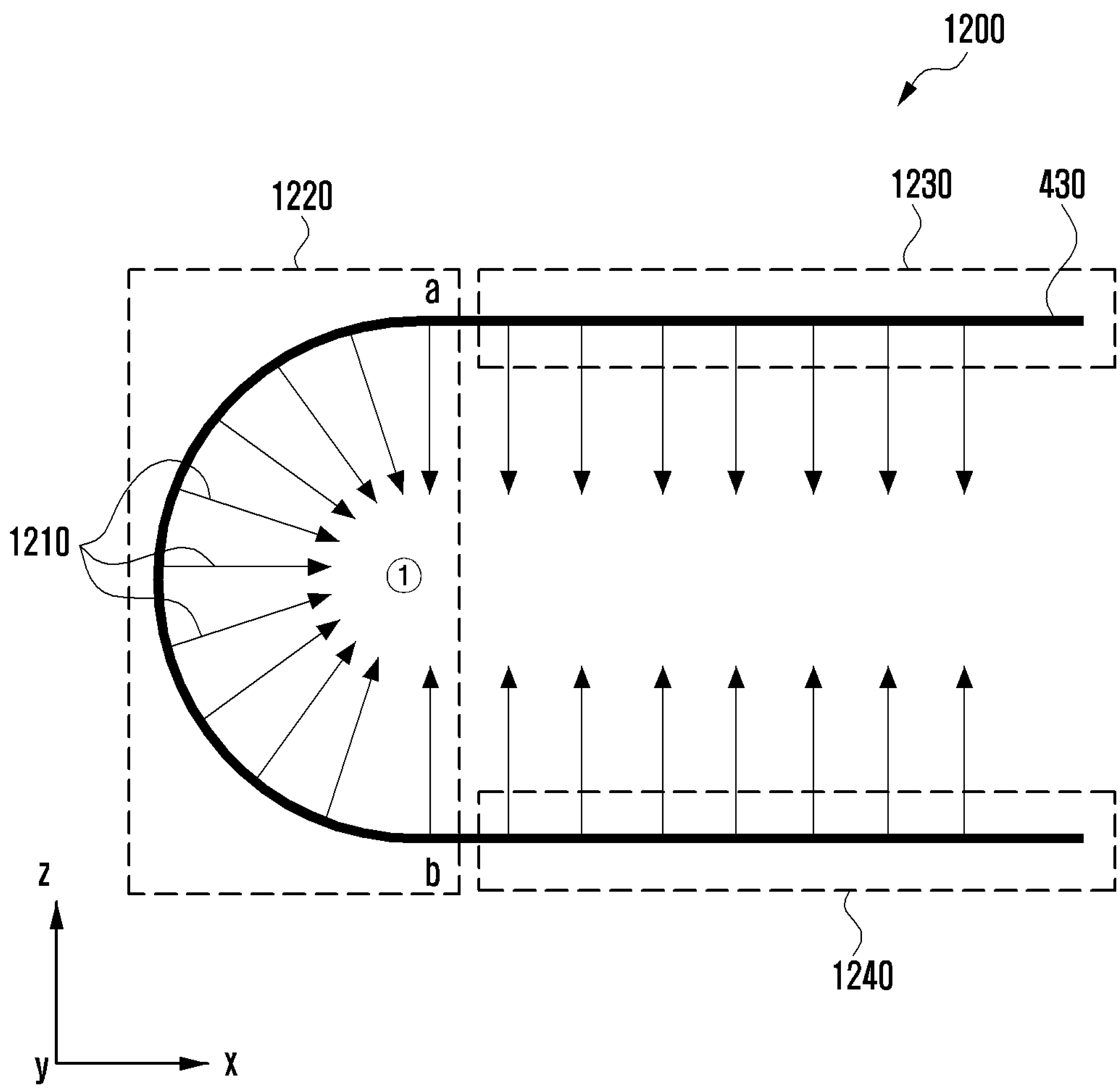


FIG. 12B

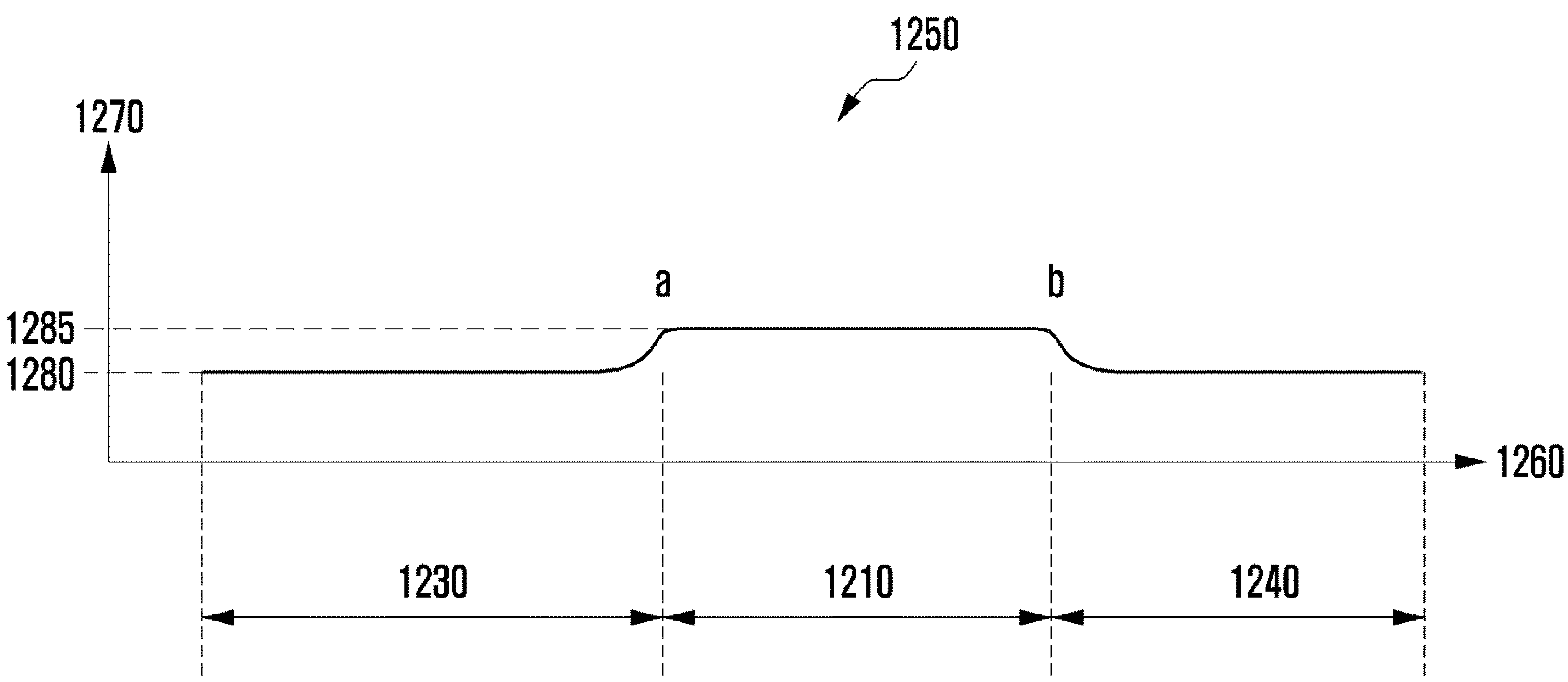


FIG. 13A

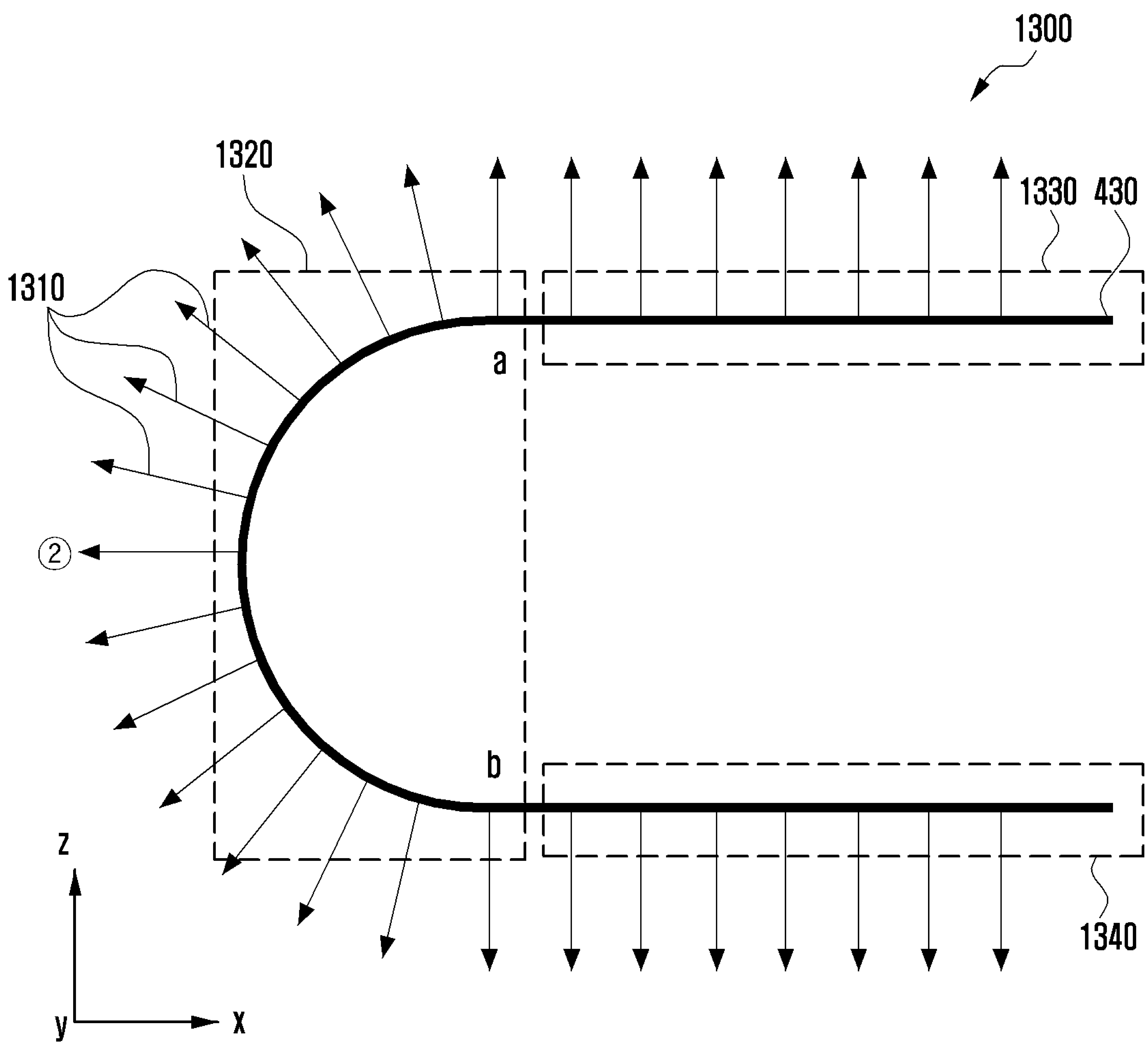


FIG. 13B

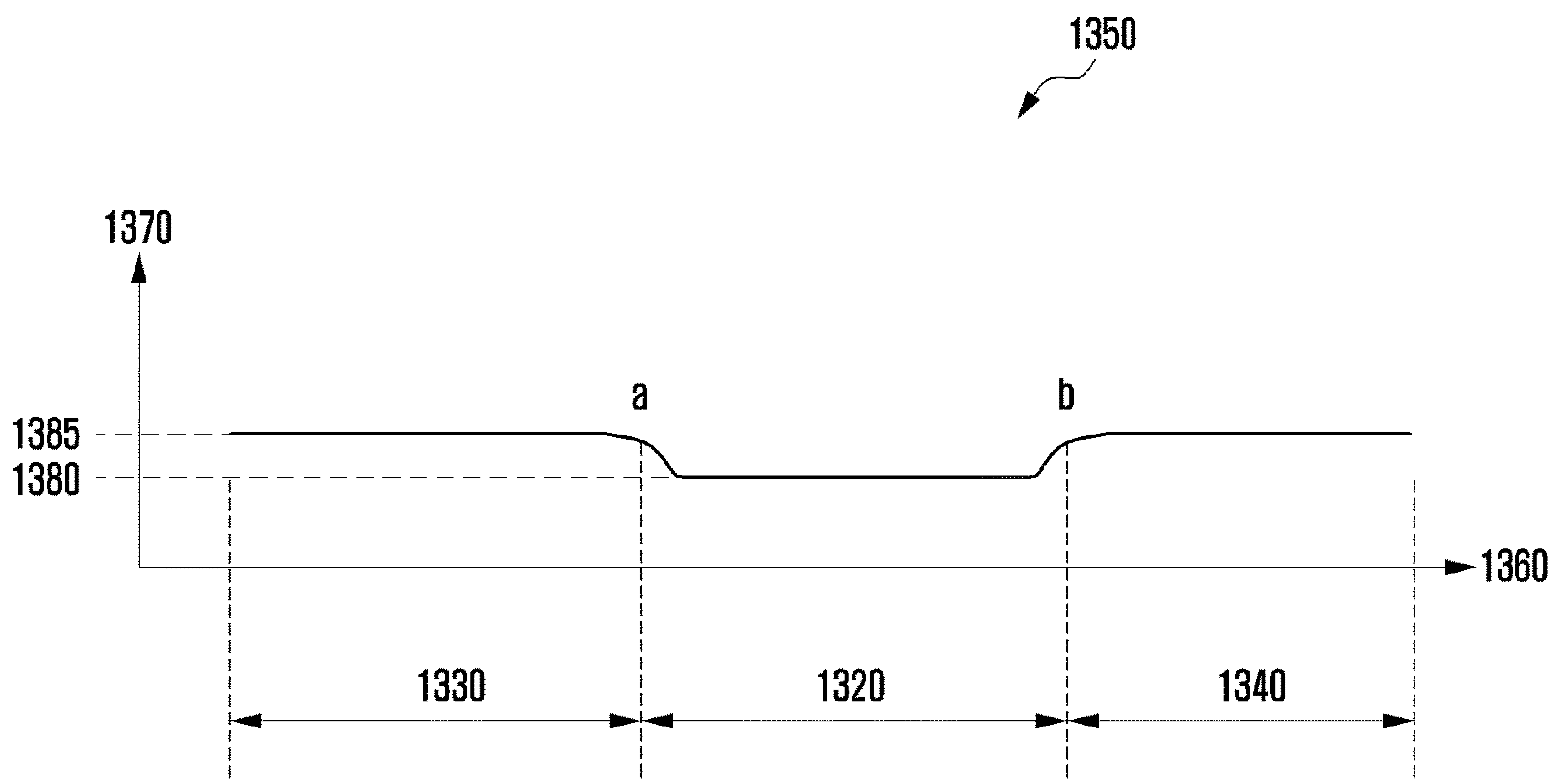


FIG. 14A

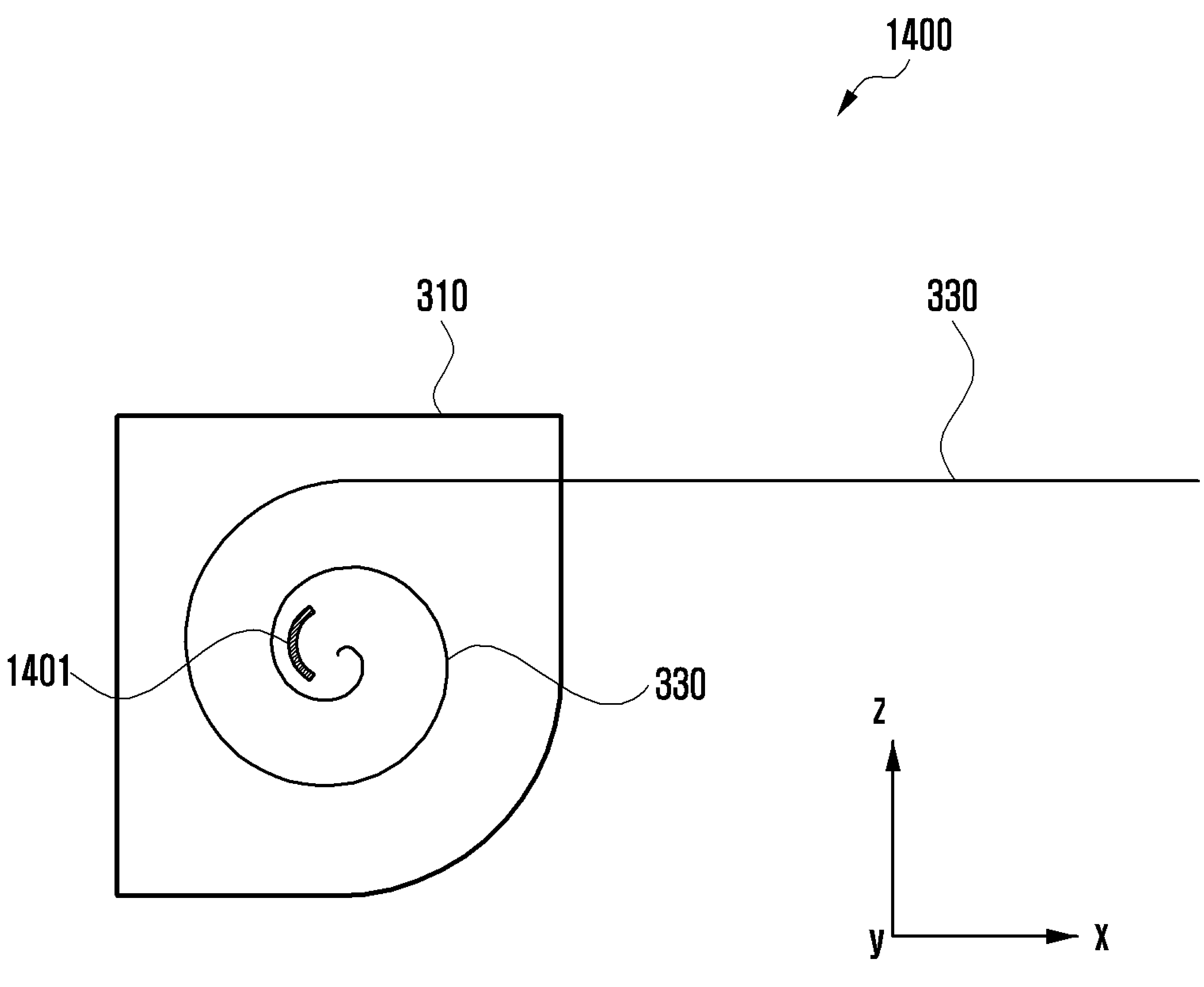


FIG. 14B

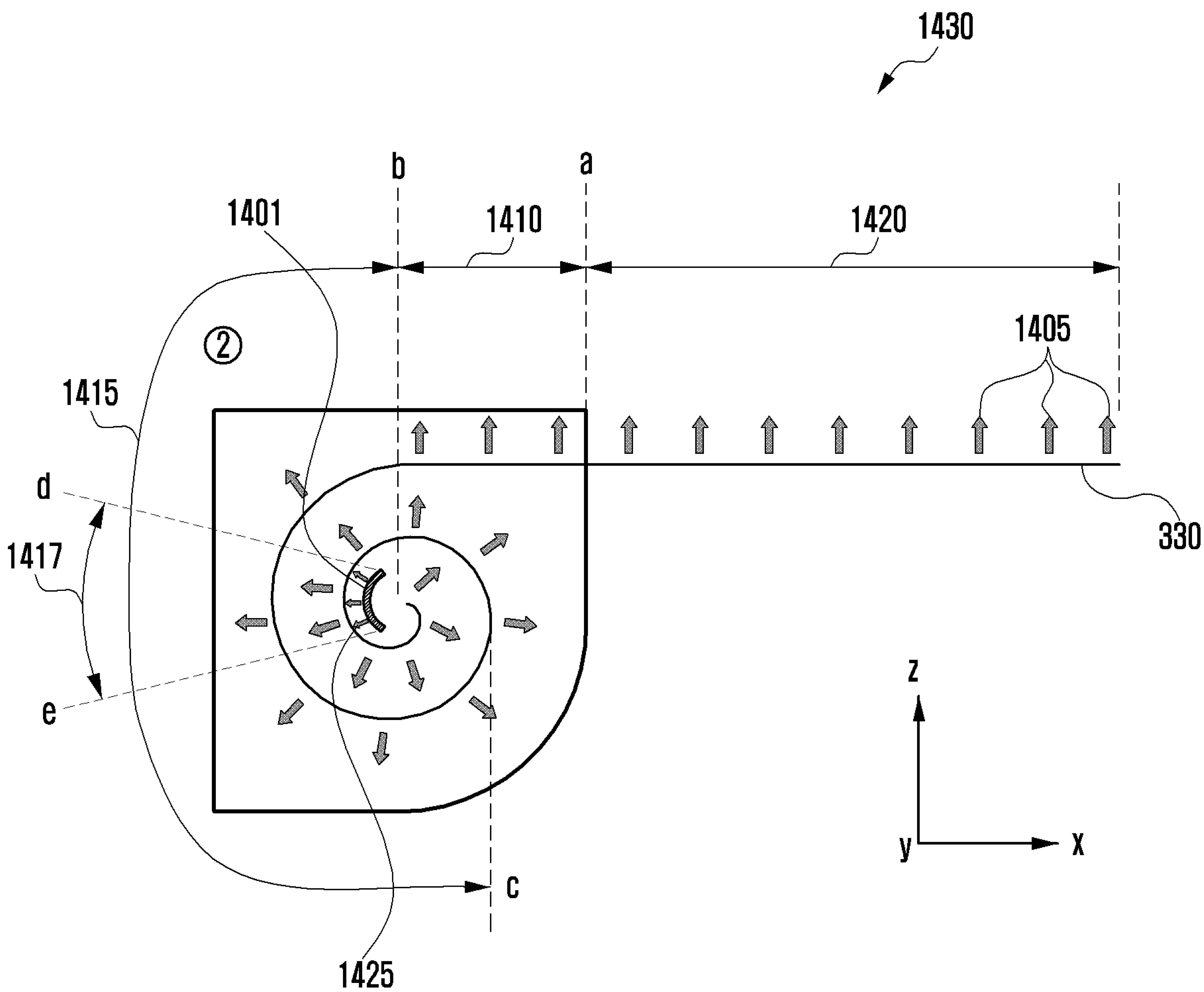


FIG. 14C

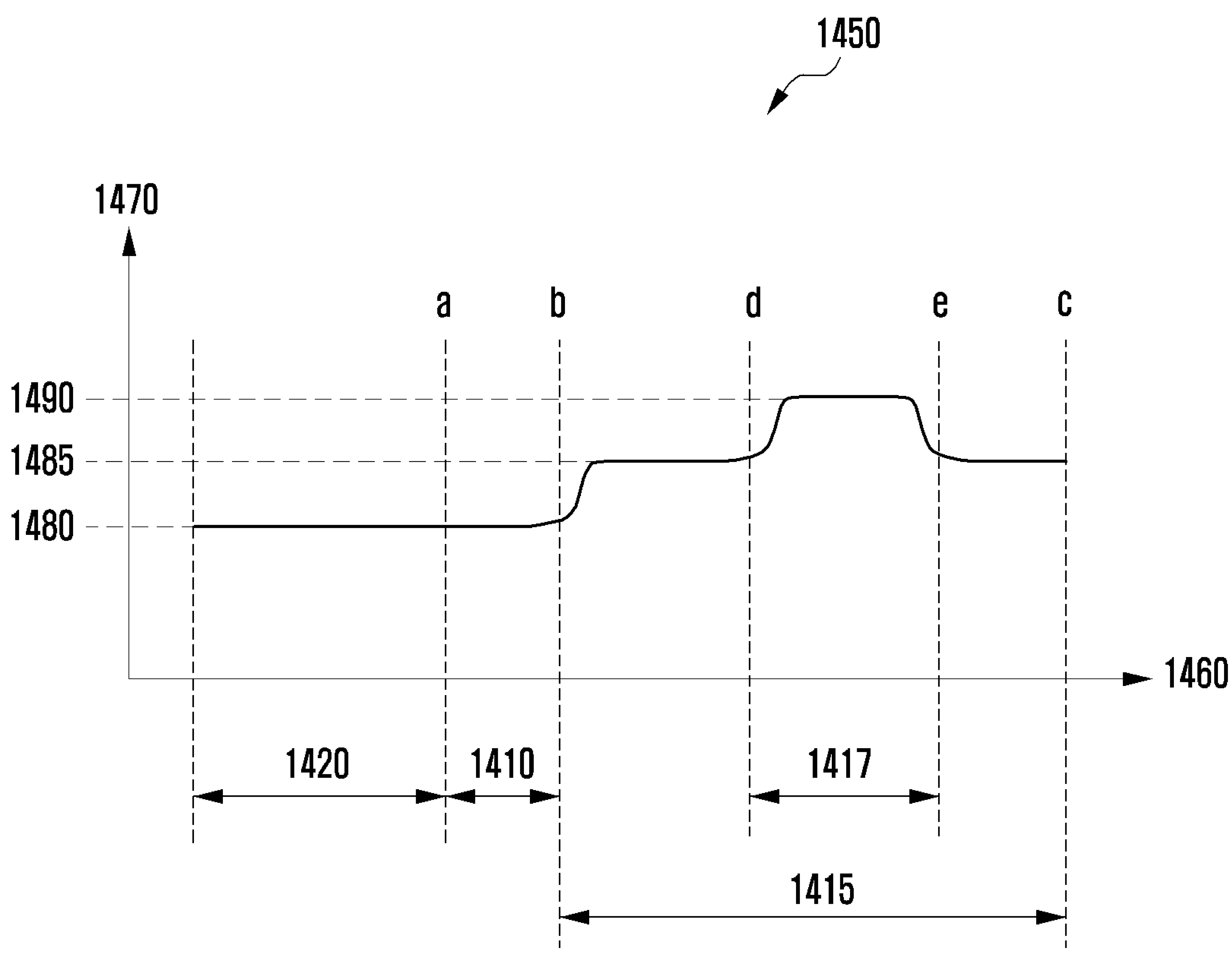


FIG. 15

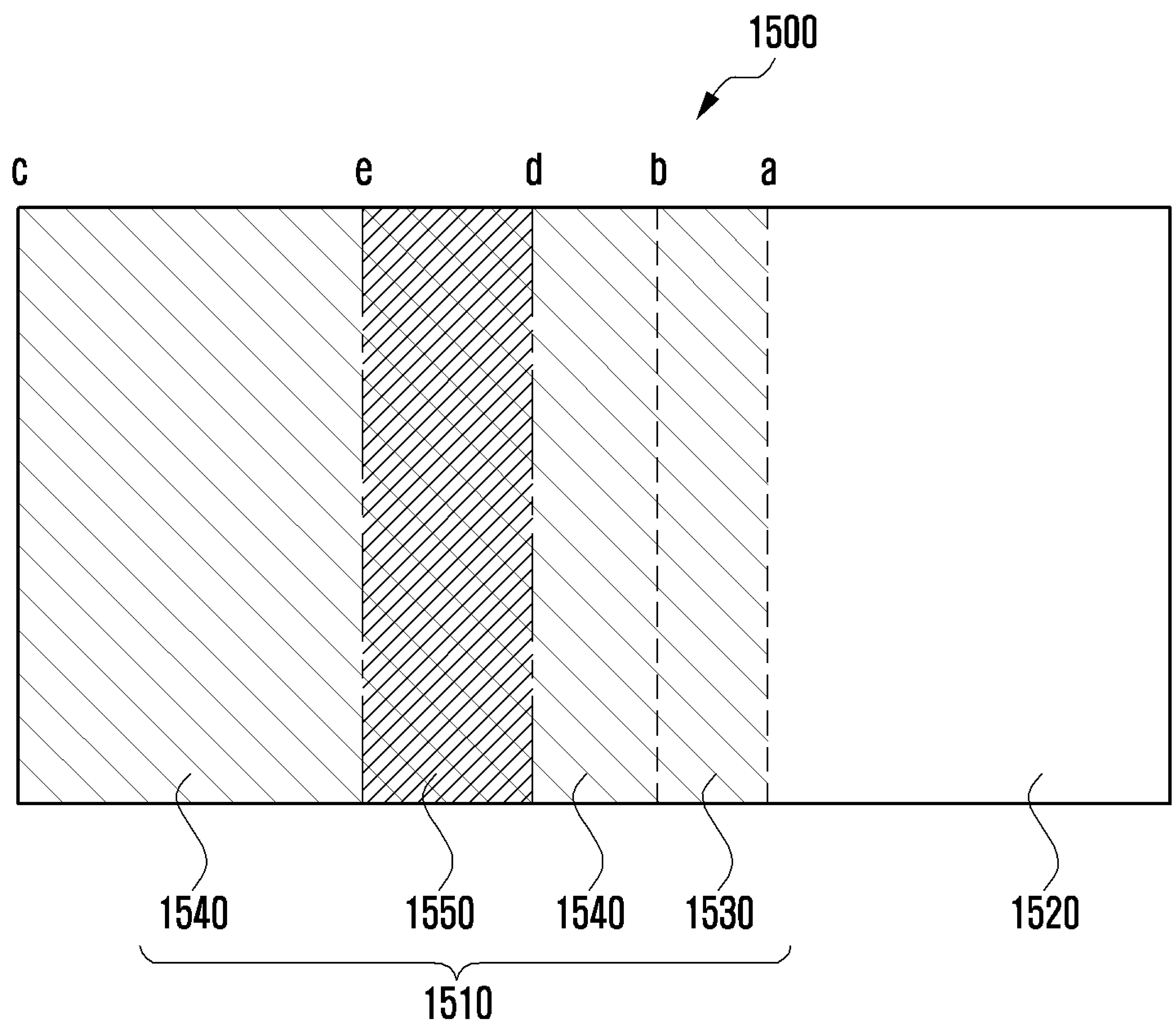


FIG. 16A

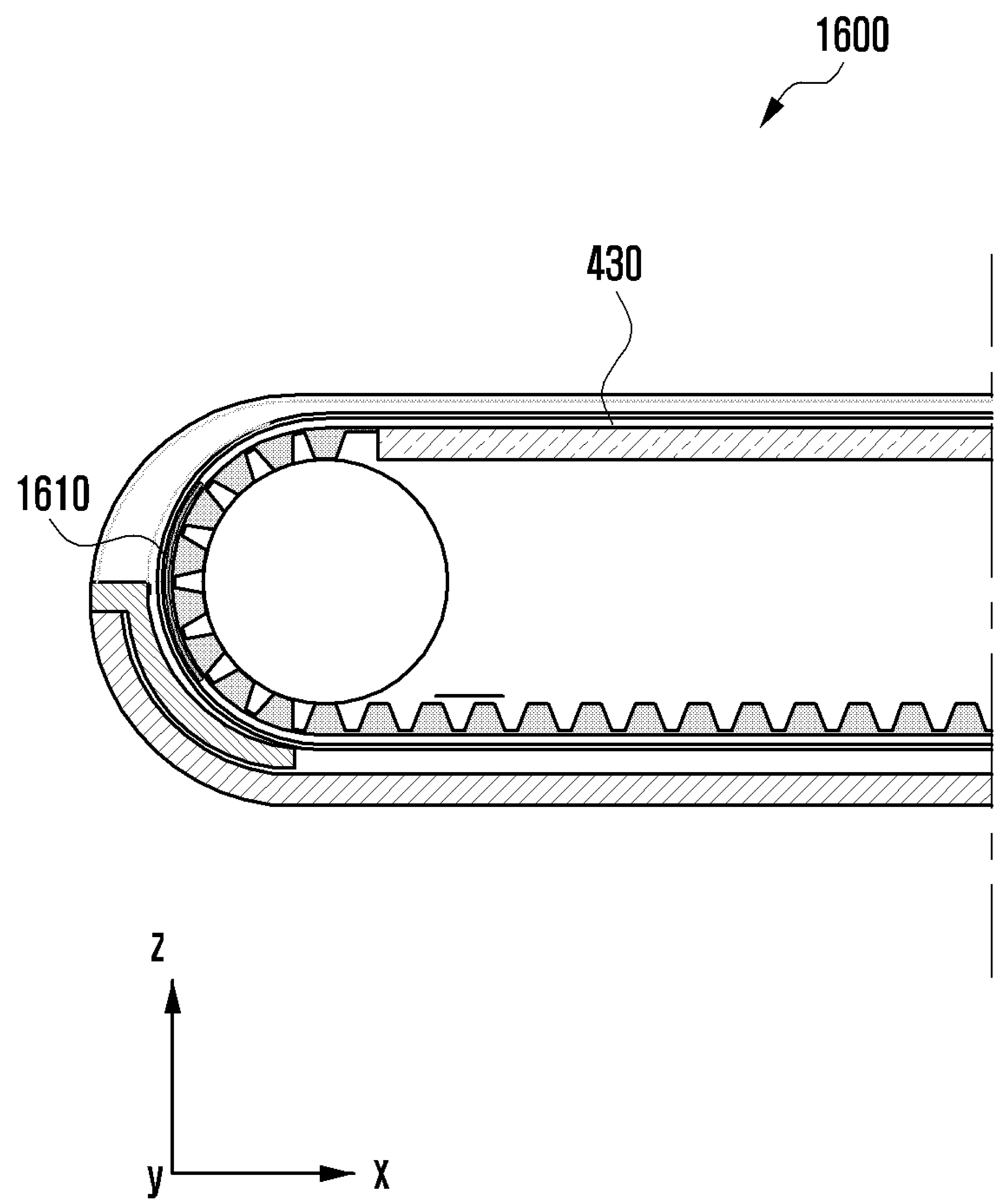


FIG. 16B

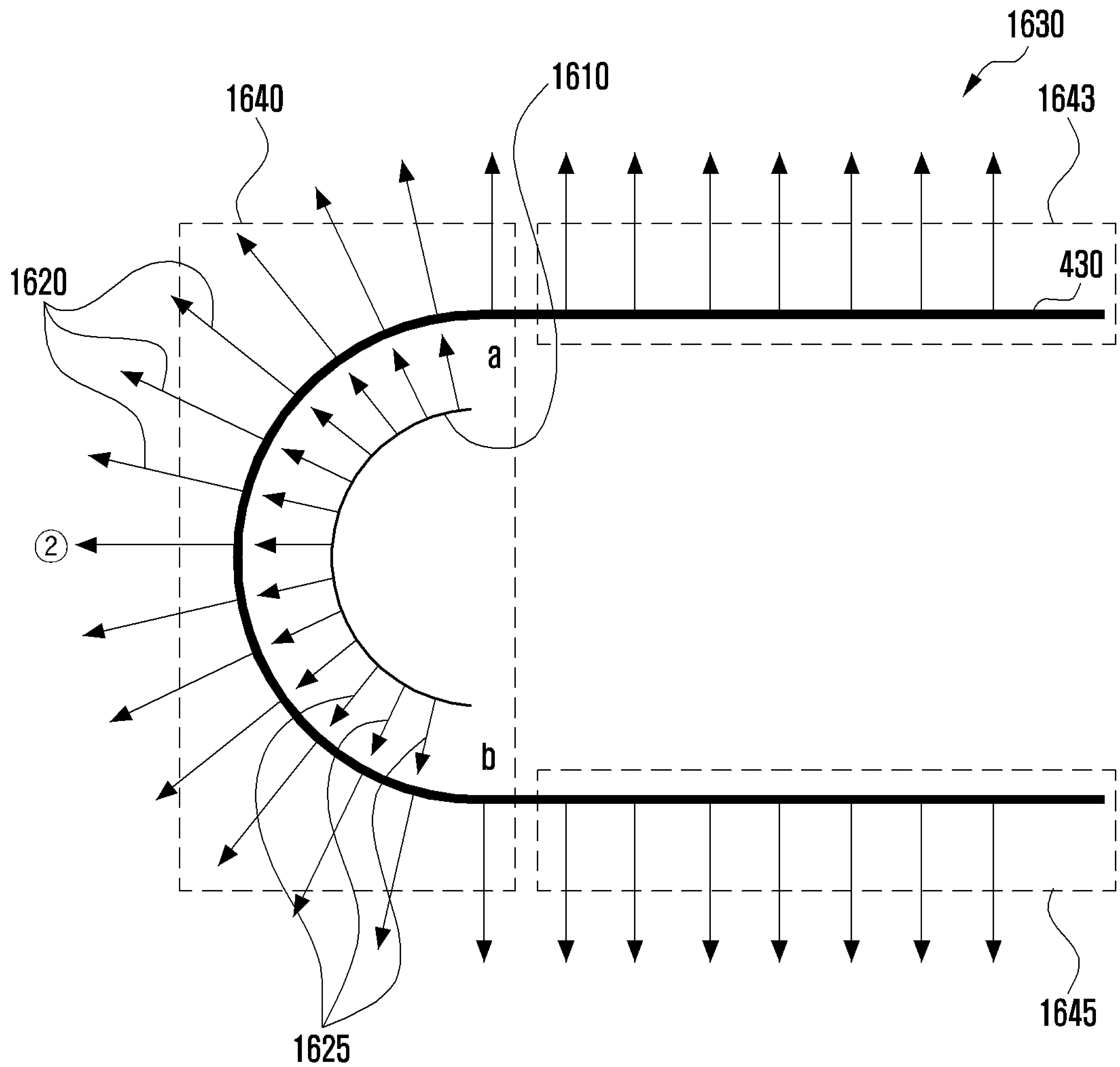


FIG. 16C

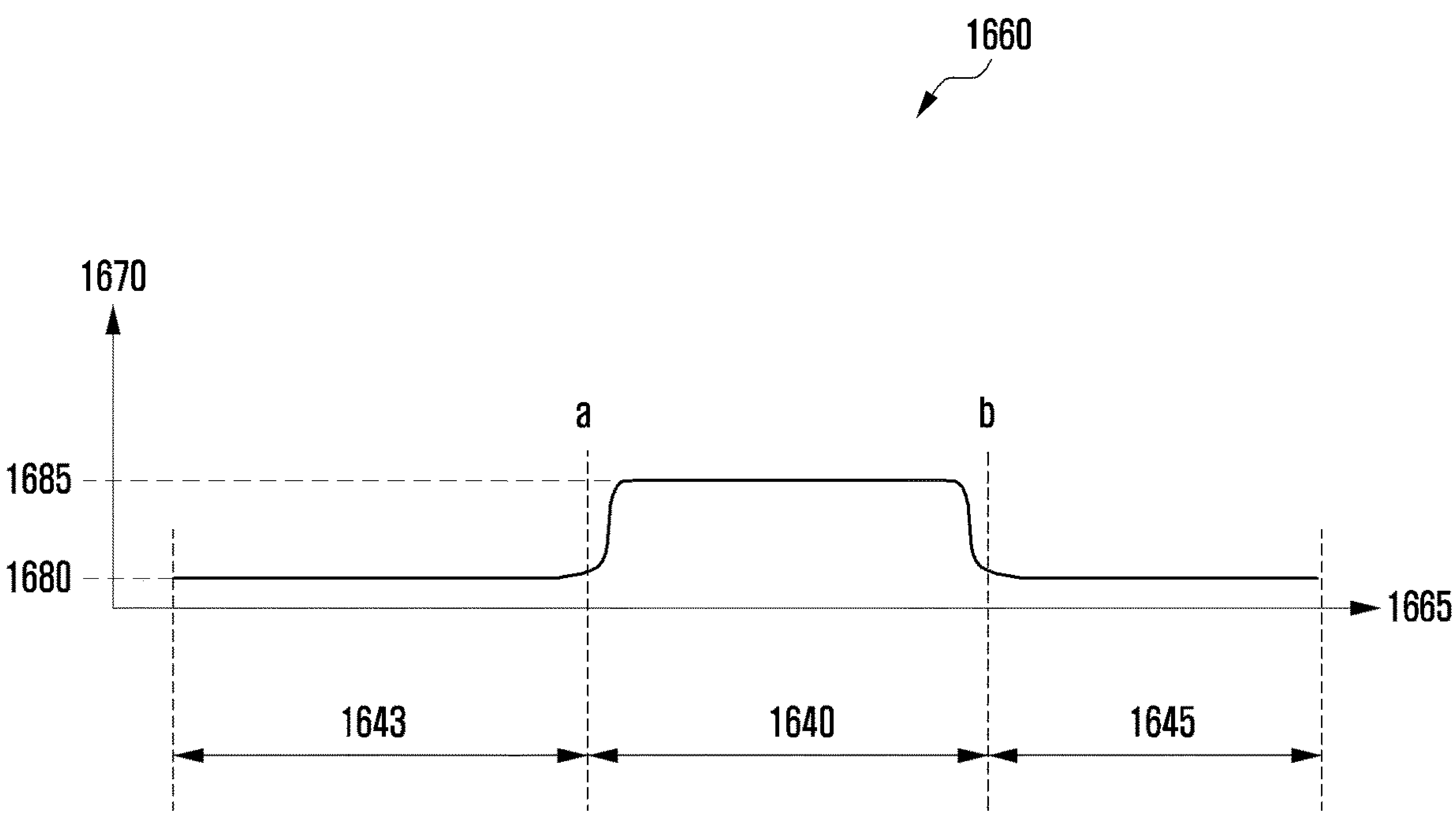


FIG. 17

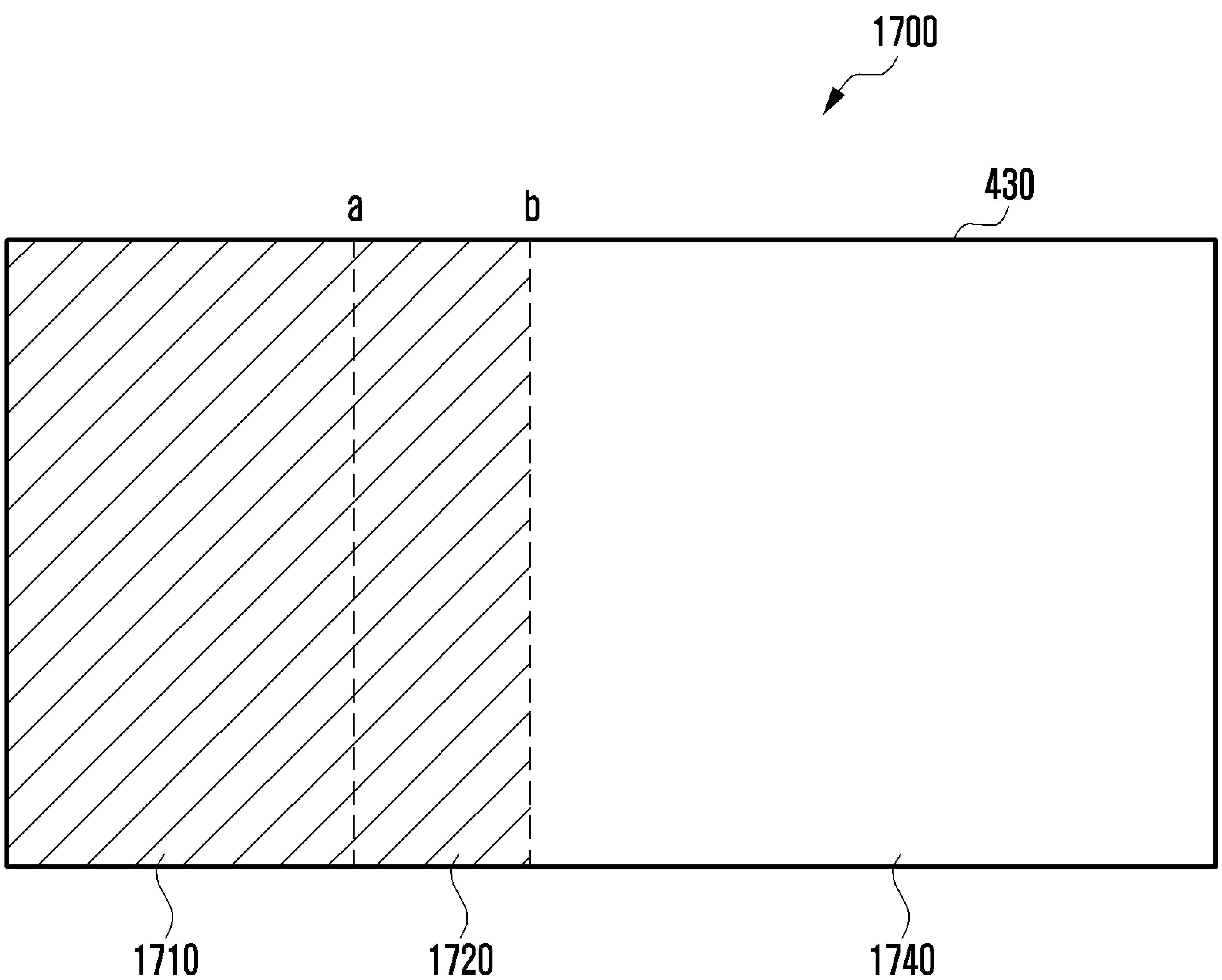


FIG. 18A

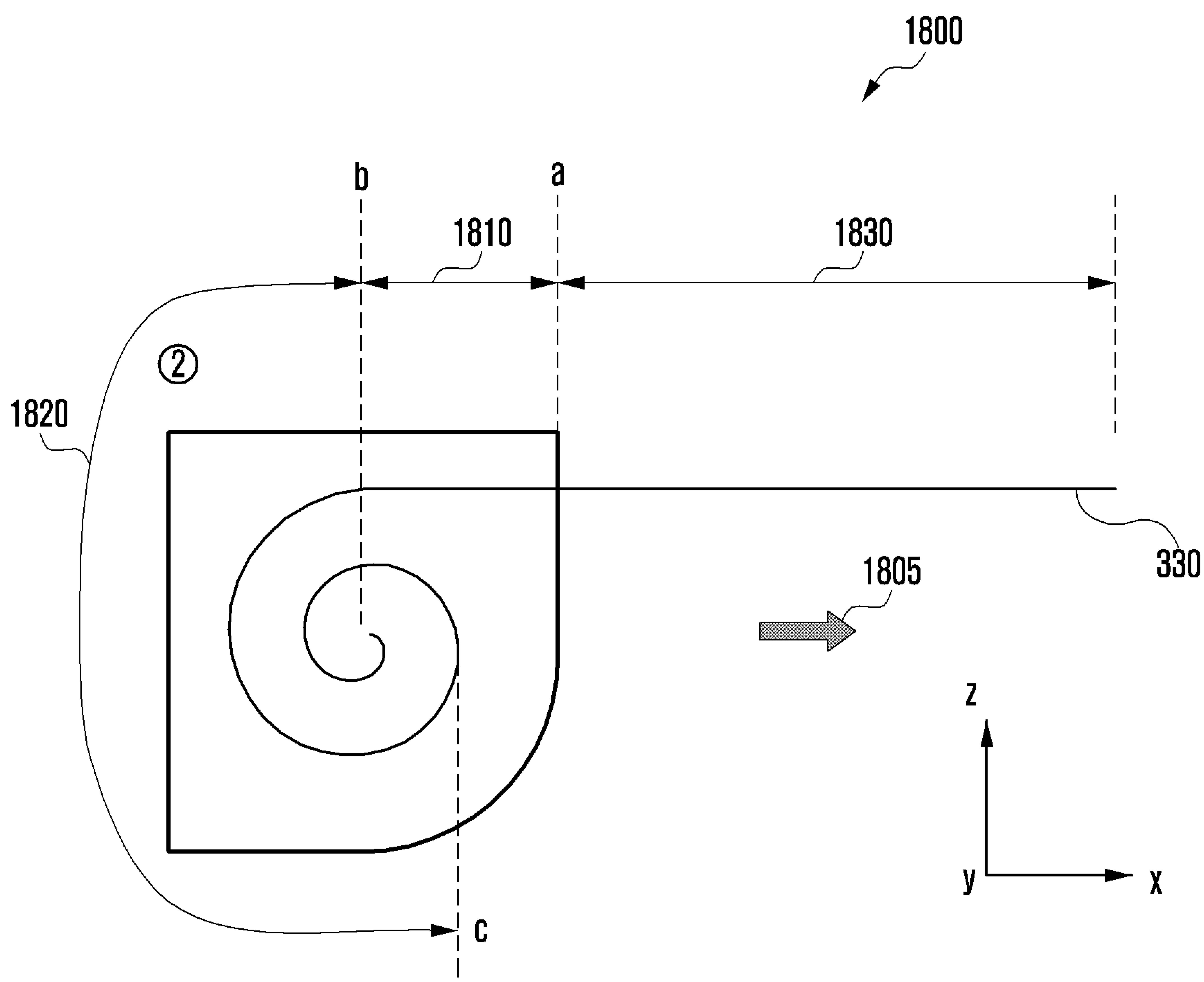


FIG. 18B

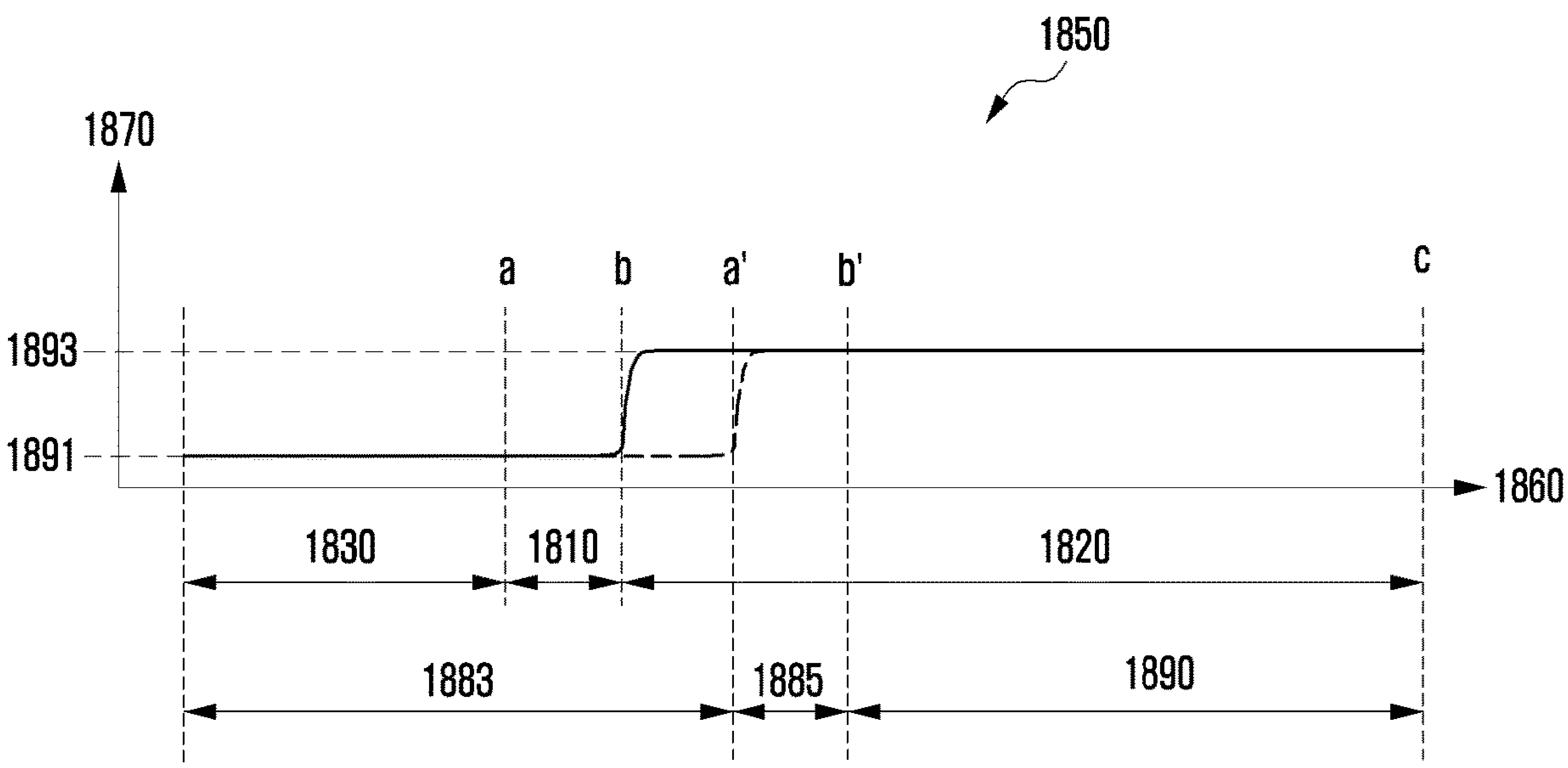


FIG. 19

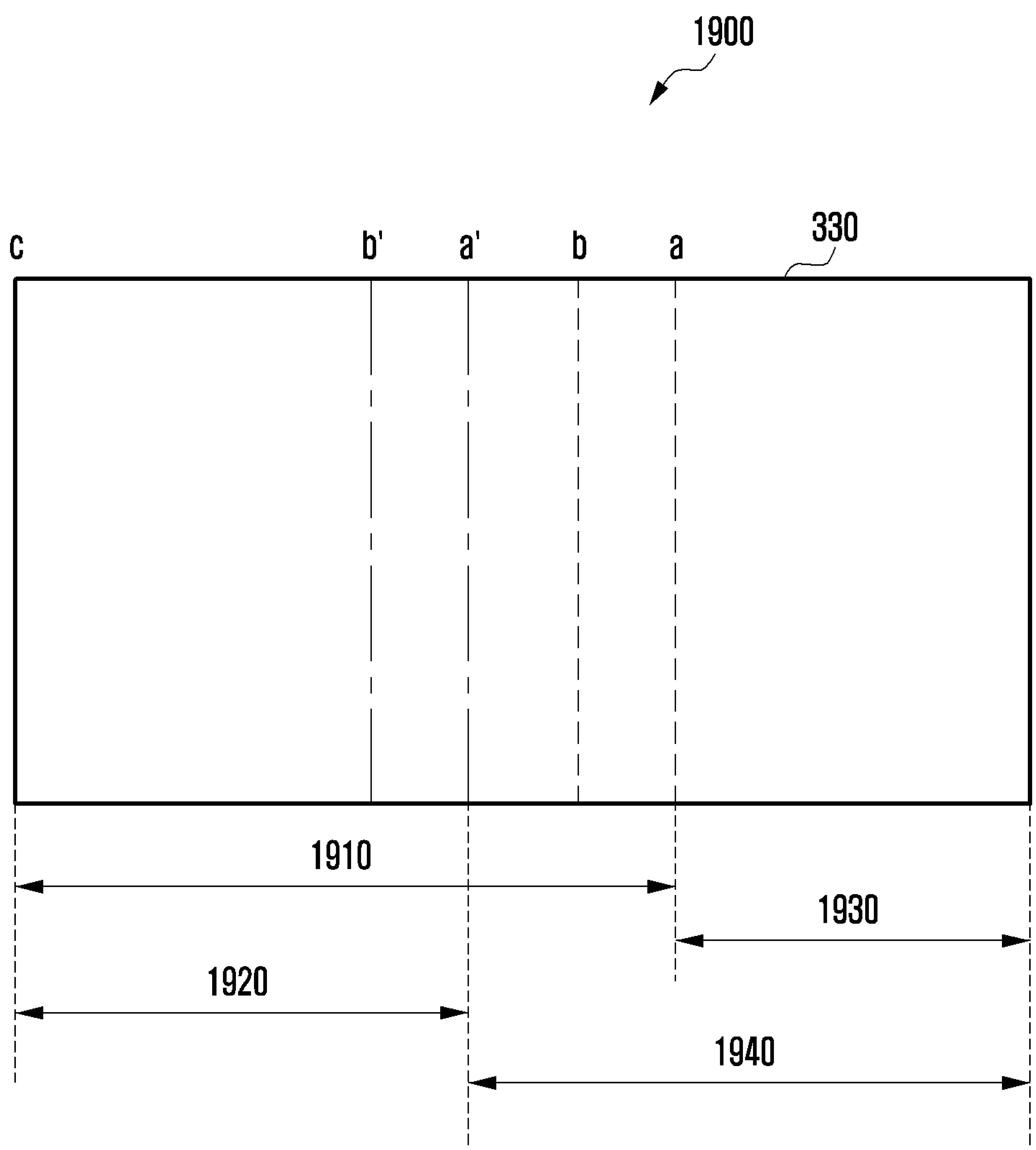


FIG. 20A

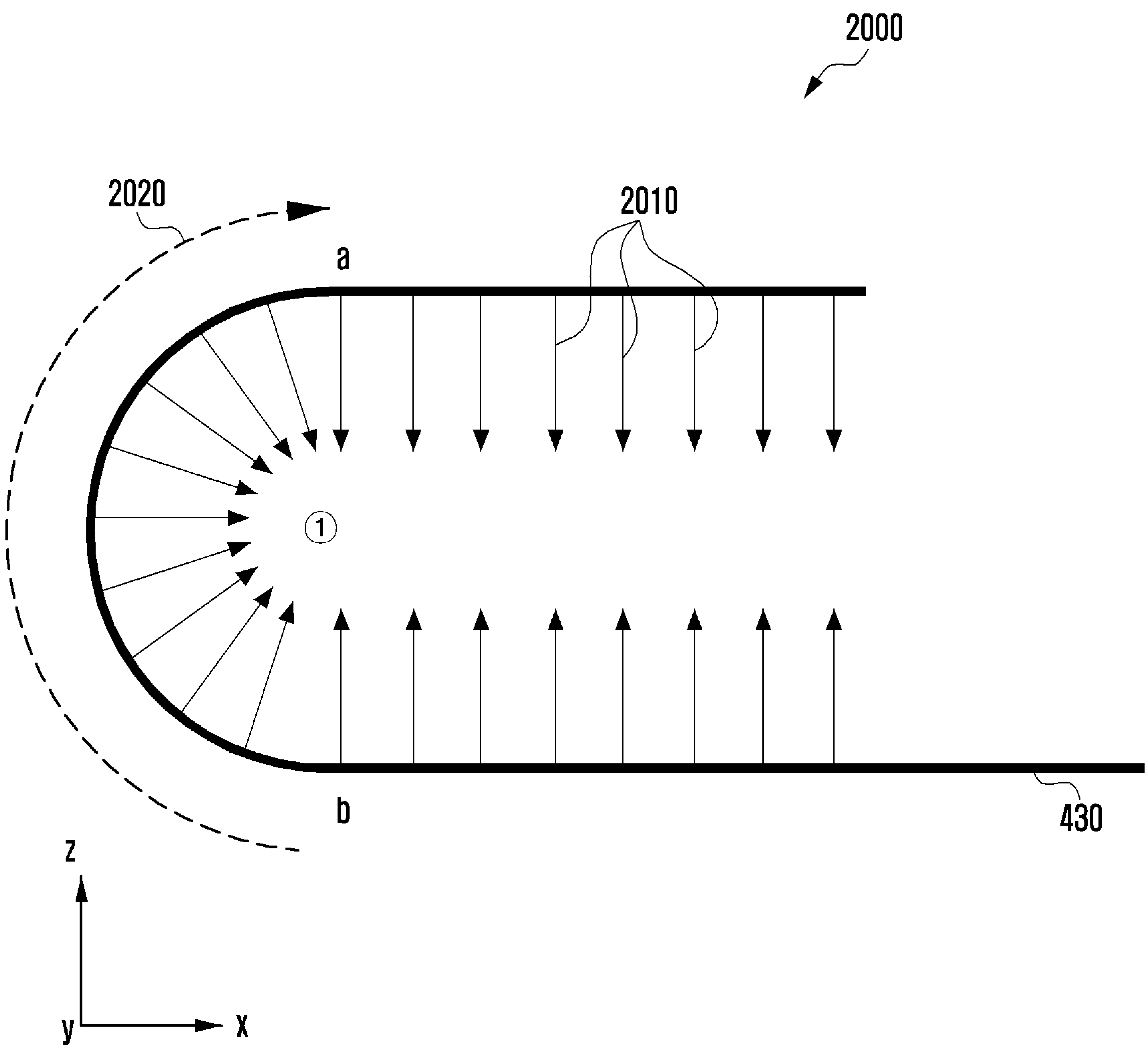


FIG. 20B

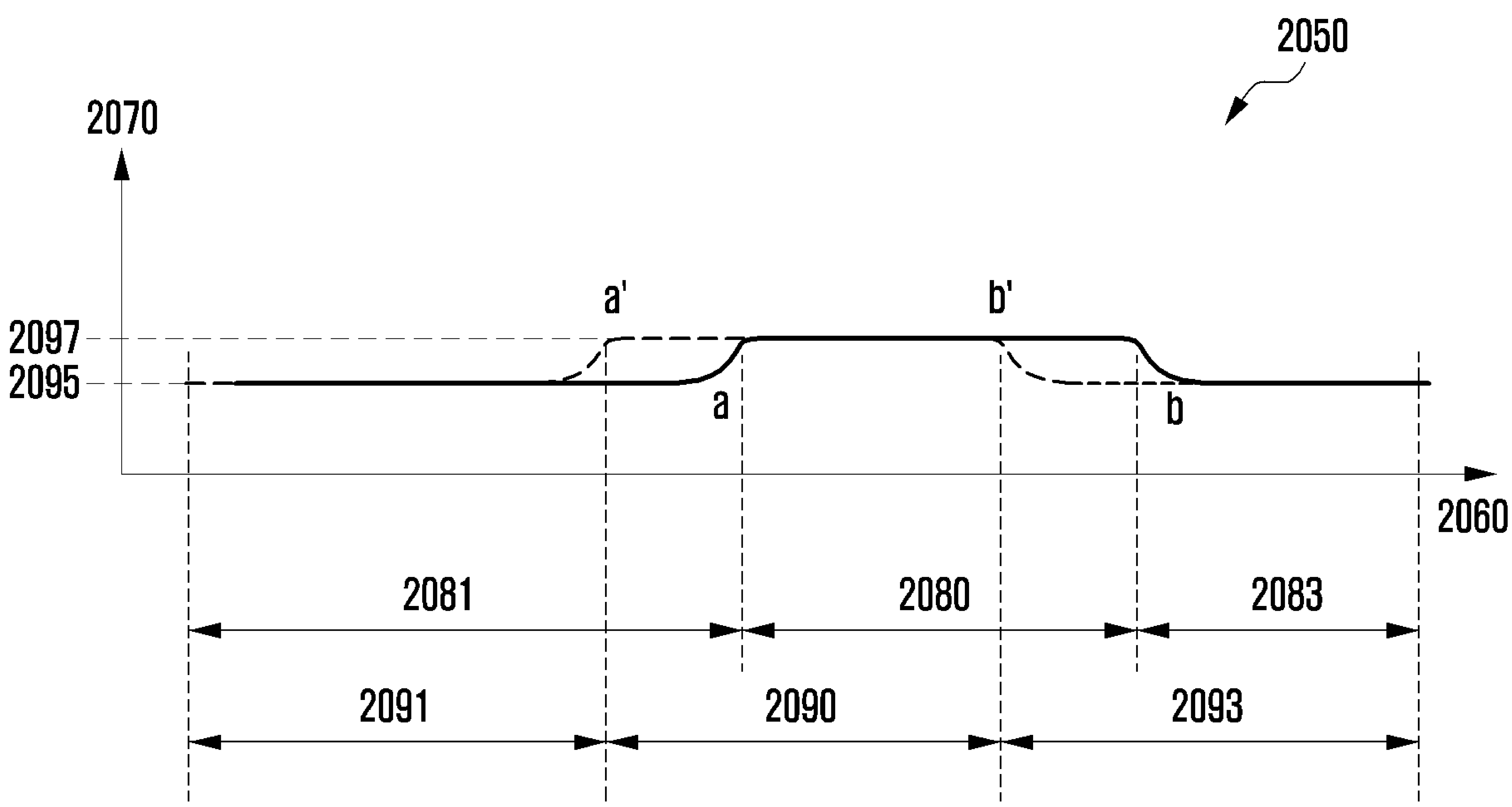
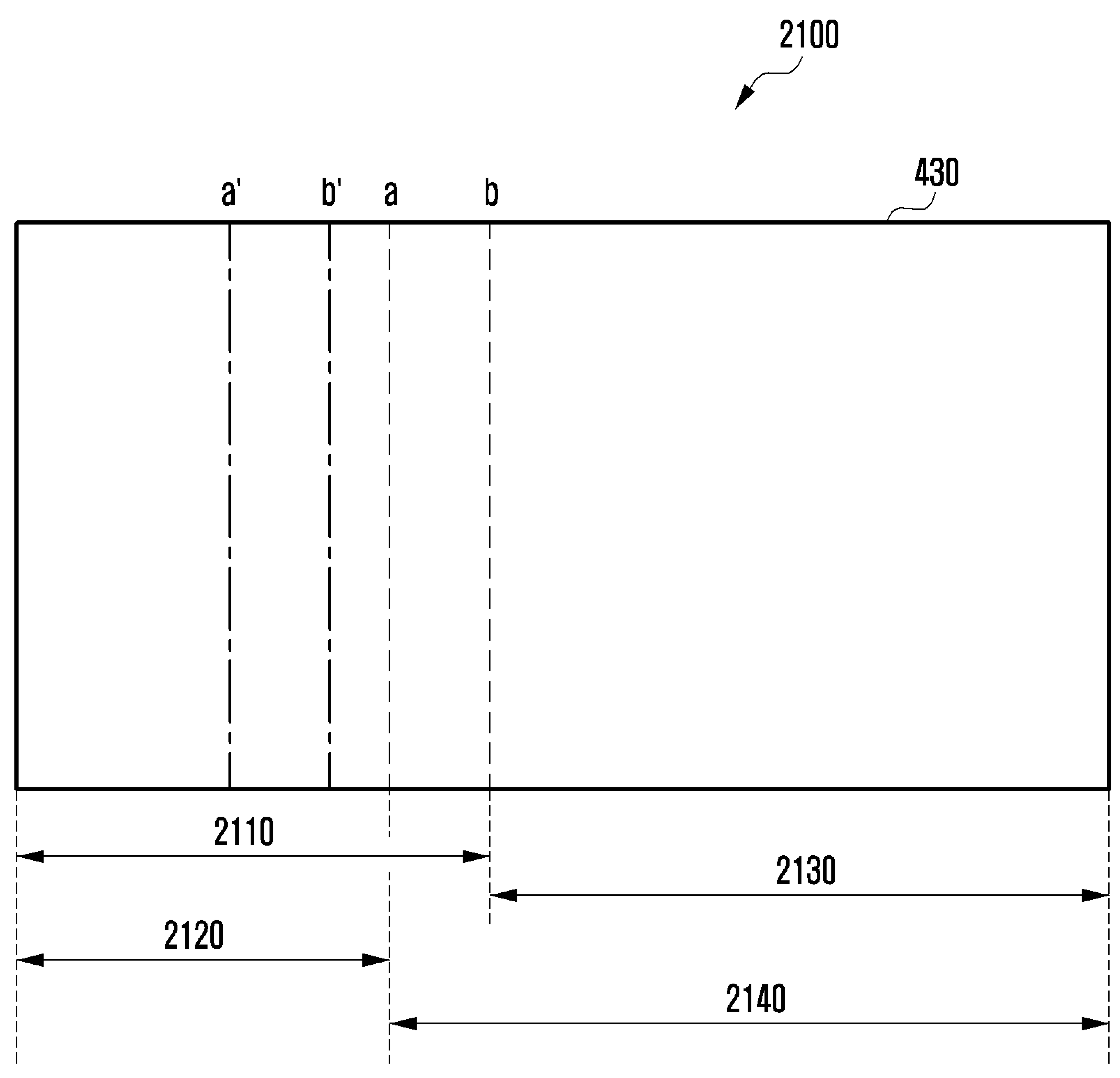


FIG. 21



ELECTRONIC DEVICE INCLUDING FLEXIBLE DISPLAY, AND DISPLAY METHOD USING SAME

CROSS-REFERENCE TO RELATED APPLICATION(S)

This application is a Bypass Continuation application of PCT International Application No. PCT/KR2021/014877, filed on Oct. 22, 2021, which is based on and claims priority to Korean Patent Application No. 10-2020-0152303, filed on Nov. 13, 2020 and Korean Patent Application No. 10-2021-0029936, filed on Mar. 8, 2021, both filed in the Korean Intellectual Property Office, the disclosures of which are incorporated by reference herein in their entireties.

BACKGROUND

1. Field

This disclosure relates to an electronic device including a flexible display and a display method using same.

2. Description of Related Art

An electronic device may have a limited size for portability and thus have limitation in the size of a display, as well. Accordingly, in recent years, various types of electronic devices providing more expanded screens have been developed. For example, electronic devices are designed to allow the size of a screen gradually to increase in a display having a limited size, and such that various services (or functions) are provided to users through larger screens.

An electronic device may have a new form factor, such as a rollable device and/or a slidable device. For example, an electronic device may include a flexible display or a slidable display, and at least a portion of the display may be used in rolled or unrolled states.

An electronic device including a flexible display or a slidable display may detect, by using a sensor, whether a display is drawn to an outer space of the electronic device, and/or the degree of withdrawal. However, it may be difficult to accurately determine the degree of withdrawal of a display from an electronic device to the external space of the electronic device.

An electronic device according to various embodiments of the disclosure may determine the degree of withdrawal of a flexible display, based on a capacitance value of a touch circuit included in the flexible display.

SUMMARY

Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the presented embodiments.

An electronic device according to various embodiments of the disclosure may include a housing, a touch circuit including multiple TX electrodes, and multiple RX electrodes arranged to cross over the multiple TX electrode, a flexible display including the touch circuit, which can be withdrawn from an inner space of the housing, a touch controller, and a processor connected to the touch panel, the flexible display, and the touch controller, wherein the touch controller applies a driving signal through the multiple TX electrodes of the touch circuit, acquires the driving signal through the multiple RX electrodes, identifies a capacitance value based on the acquired driving signal, and identifies information about a folded area of the flexible display based on the capacitance value, and the processor may configure an activation area with respect to an unfolded area of the flexible display based on the information about the folded area of the flexible display.

A display method of an electronic device including a flexible display according to various embodiments of the disclosure may include an operation of applying a driving signal by using multiple TX electrodes of a touch circuit included in the flexible display, an operation of acquiring the driving signal through the multiple RX electrodes of the touch circuit, an operation of identifying a capacitance value based on the acquired driving signal, an operation of identifying information about a folded area of the flexible display based on the capacitance value, and an operation of configuring an activation area with respect to an unfolded area of the flexible display based on the information about the folded area of the flexible display.

An electronic device according to various embodiments of the disclosure may accurately determine a display area according to a degree of withdrawal of a flexible display to an outer space of the electronic device, based on a capacitance value of a touch circuit included in the flexible display. Accordingly, the electronic device may deactivate an area other than the display area of the flexible display and prevent a malfunction of a touch input, which may occur in the deactivated area.

An electronic device according to various embodiments of the disclosure may activate only a display area determined based on a capacitance value of a touch circuit, among the whole area of the flexible display. Therefore, current consumption of the electronic device may be reduced.

BRIEF DESCRIPTION OF DRAWINGS

The above and other aspects and features of certain embodiments of the present disclosure will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a block diagram illustrating an electronic device in a network environment according to various embodiments.

FIG. **2** is a block diagram of a display module according to various embodiments.

FIG. **3**A is a perspective view of an electronic device in a closed state according to various embodiments.

FIG. **3**B is a perspective view of an electronic device in an open state according to various embodiments.

FIG. **4**A is a front perspective view of an electronic device in a closed state according to various embodiments.

FIG. **4**B is a front perspective view of an electronic device in an open state according to various embodiments.

FIG. **5**A is a view of multiple electrodes constituting a touch circuit included in a flexible display according to various embodiments.

FIG. **5**B is a view illustrating an image formed based on raw data for a capacitance value of a flexible display of an electronic device according to various embodiments.

FIG. **5**C is a view illustrating an image formed based on raw data for a capacitance value of a flexible display of an electronic device according to various embodiments.

FIG. **6**A is a front view of an electronic device viewed from one side according to various embodiments.

FIG. 6B is an enlarged view of a specific area of the flexible display of FIG. 6A according to various embodiments.

FIG. 7 is a front view of an electronic device viewed from one side according to various embodiments.

FIG. 8 is a block diagram illustrating an electronic device according to various embodiments.

FIG. 9 is a flowchart explaining a method for determining an activation area of a flexible display according to various embodiments.

FIG. 10A is a view explaining a method for applying a driving signal from a transmitter including multiple first electrode lines constituting a touch circuit of a flexible display according to various embodiments.

FIG. 10B is a view explaining a method for identifying a capacitance value based on acquisition of a driving signal through a receiver including multiple second electrode lines constituting a touch circuit of a flexible display according to various embodiments.

FIG. 11A is a view explaining a method for applying a driving signal from a transmitter including multiple first electrode lines constituting a touch circuit of a flexible display according to various embodiments.

FIG. 11B is a view explaining a method for identifying a capacitance value based on acquisition of a driving signal through a receiver including multiple second electrode lines constituting a touch circuit of a flexible display according to various embodiments.

FIG. 12A is a view explaining a method for applying a driving signal from a transmitter including multiple first electrode lines constituting a touch circuit of a flexible display according to various embodiments.

FIG. 12B is a view explaining a method for detecting a capacitance change based on acquisition of a driving signal through a receiver including multiple second electrode lines constituting a touch circuit of a flexible display according to various embodiments.

FIG. 13A is a view explaining a method for applying a driving signal from a transmitter including multiple first electrode lines constituting a touch circuit of a flexible display according to various embodiments.

FIG. 13B is a view explaining a method for detecting a capacitance value based on acquisition of a driving signal through a receiver including multiple second electrode lines constituting a touch circuit of a flexible display according to various embodiments.

FIG. 14A is a view illustrating a semicircular conductor disposed in an inner space of a housing of an electronic device according to various embodiments.

FIG. 14B is a view explaining a method for applying a driving signal from a transmitter including multiple first electrode lines constituting a touch circuit of a flexible display according to various embodiments.

FIG. 14C is a view explaining a method for identifying a capacitance value based on acquisition of a driving signal through a receiver including multiple second electrode lines constituting a touch circuit of a flexible display according to various embodiments.

FIG. 15 is a view explaining a method for determining an activation area of a flexible display according to various embodiments.

FIG. 16A is a view illustrating a semicircular conductor disposed in an inner space of a housing of an electronic device according to various embodiments.

FIG. 16B is a flowchart explaining a method for applying a driving signal from a transmitter including multiple first electrode lines constituting a touch circuit of a flexible display according to various embodiments.

FIG. 16C is a flowchart explaining a method for detecting a capacitance value based on acquisition of a driving signal through a receiver including multiple second electrode lines constituting a touch circuit of a flexible display according to various embodiments.

FIG. 17 is a view explaining a method for determining an activation area of a flexible display according to various embodiments.

FIG. 18A and FIG. 18B views explaining a method for changing an activation area of a flexible display based on detection of a state change of the flexible display according to various embodiments.

FIG. 19 a view explaining a method for changing an activation area of a flexible display based on detection of a state change of the flexible display according to various embodiments.

FIG. 20A and FIG. 20B views explaining a method for changing an activation area of a flexible display based on detection of a state change of the flexible display according to various embodiments.

FIG. 21 a view explaining a method for changing an activation area of a flexible display based on detection of a state change of the flexible display according to various embodiments.

DETAILED DESCRIPTION

FIG. 1 is a block diagram illustrating an electronic device **101** in a network environment **100** according to various embodiments.

Referring to FIG. 1, an electronic device **101** in a network environment **100** may communicate with an electronic device **102** via a first network **198** (e.g., a short-range wireless communication network), or at least one of an electronic device **104** or a server **108** via a second network **199** (e.g., a long-range wireless communication network). According to an embodiment, the electronic device **101** may communicate with the electronic device **104** via the server **108**. According to an embodiment, the electronic device **101** may include a processor **120**, memory **130**, an input module **150**, a sound output module **155**, a display module **160**, an audio module **170**, a sensor module **176**, an interface **177**, a connection terminal **178**, a haptic module **179**, a camera module **180**, a power management module **188**, a battery **189**, a communication module **190**, a subscriber identification module (SIM) **196**, or an antenna module **197**. In some embodiments, at least one of the components (e.g., the connection terminal **178**) may be omitted from the electronic device **101**, or one or more other components may be added in the electronic device **101**. In some embodiments, some of the components (e.g., the sensor module **176**, the camera module **180**, or the antenna module **197**) may be implemented as a single component (e.g., the display module **160**).

The processor **120** may execute, for example, software (e.g., a program **140**) to control at least one other component (e.g., a hardware or software component) of the electronic device **101** coupled with the processor **120**, and may perform various data processing or computation. According to one embodiment, as at least part of the data processing or computation, the processor **120** may store a command or data received from another component (e.g., the sensor module **176** or the communication module **190**) in volatile memory **132**, process the command or the data stored in the volatile memory **132**, and store resulting data in non-volatile memory **134**. According to an embodiment, the processor **120** may include a main processor **121** (e.g., a central processing unit (CPU) or an application processor (AP)), or an auxiliary processor **123** (e.g., a graphics processing unit (GPU), a neural processing unit (NPU), an image signal processor (ISP), a sensor hub processor, or a communication processor (CP)) that is operable independently from, or in conjunction with, the main processor **121**. For example, when the electronic device **101** includes the main processor **121** and the auxiliary processor **123**, the auxiliary processor **123** may be adapted to consume less power than the main processor **121**, or to be specific to a specified function. The auxiliary processor **123** may be implemented as separate from, or as part of the main processor **121**.

The auxiliary processor **123** may control at least some of functions or states related to at least one component (e.g., the display module **160**, the sensor module **176**, or the communication module **190**) among the components of the electronic device **101**, instead of the main processor **121** while the main processor **121** is in an inactive (e.g., sleep) state, or together with the main processor **121** while the main processor **121** is in an active state (e.g., executing an application). According to an embodiment, the auxiliary processor **123** (e.g., an image signal processor or a communication processor) may be implemented as part of another component (e.g., the camera module **180** or the communication module **190**) functionally related to the auxiliary processor **123**. According to an embodiment, the auxiliary processor **123** (e.g., the neural processing unit) may include a hardware structure specified for artificial intelligence model processing. An artificial intelligence model may be generated by machine learning. Such learning may be performed, e.g., by the electronic device **101** where the artificial intelligence is performed or via a separate server (e.g., the server **108**). Learning algorithms may include, but are not limited to, e.g., supervised learning, unsupervised learning, semi-supervised learning, or reinforcement learning. The artificial intelligence model may include a plurality of artificial neural network layers. The artificial neural network may be a deep neural network (DNN), a convolutional neural network (CNN), a recurrent neural network (RNN), a restricted boltzmann machine (RBM), a deep belief network (DBN), a bidirectional recurrent deep neural network (BRDNN), deep Q-network or a combination of two or more thereof but is not limited thereto. The artificial intelligence model may, additionally or alternatively, include a software structure other than the hardware structure.

The memory **130** may store various data used by at least one component (e.g., the processor **120** or the sensor module **176**) of the electronic device **101**. The various data may include, for example, software (e.g., the program **140**) and input data or output data for a command related thereto. The memory **130** may include the volatile memory **132** or the non-volatile memory **134**. The non-volatile memory **134** may include an internal memory **136** and/or an external memory **138**.

The program **140** may be stored in the memory **130** as software, and may include, for example, an operating system (OS) **142**, middleware **144**, or an application **146**.

The input module **150** may receive a command or data to be used by another component (e.g., the processor **120**) of the electronic device **101**, from the outside (e.g., a user) of the electronic device **101**. The input module **150** may include, for example, a microphone, a mouse, a keyboard, a key (e.g., a button), or a digital pen (e.g., a stylus pen).

The sound output module **155** may output sound signals to the outside of the electronic device **101**. The sound output module **155** may include, for example, a speaker or a receiver. The speaker may be used for general purposes, such as playing multimedia or playing record. The receiver may be used for receiving incoming calls. According to an embodiment, the receiver may be implemented as separate from, or as part of the speaker.

The display module **160** may visually provide information to the outside (e.g., a user) of the electronic device **101**. The display module **160** may include, for example, a display, a hologram device, or a projector and control circuitry to control a corresponding one of the display, hologram device, and projector. According to an embodiment, the display module **160** may include a touch sensor adapted to detect a touch, or a pressure sensor adapted to measure the intensity of force incurred by the touch.

The audio module **170** may convert a sound into an electrical signal and vice versa. According to an embodiment, the audio module **170** may obtain the sound via the input module **150**, or output the sound via the sound output module **155** or a headphone of an external electronic device (e.g., an electronic device **102**) (e.g., speaker or headphone) directly (e.g., wiredly) or wirelessly coupled with the electronic device **101**.

The sensor module **176** may detect an operational state (e.g., power or temperature) of the electronic device **101** or an environmental state (e.g., a state of a user) external to the electronic device **101**, and then generate an electrical signal or data value corresponding to the detected state. According to an embodiment, the sensor module **176** may include, for example, a gesture sensor, a gyro sensor, an atmospheric pressure sensor, a magnetic sensor, an acceleration sensor, a grip sensor, a proximity sensor, a color sensor, an infrared (IR) sensor, a biometric sensor, a temperature sensor, a humidity sensor, or an illuminance sensor.

The interface **177** may support one or more specified protocols to be used for the electronic device **101** to be coupled with the external electronic device (e.g., the electronic device **102**) directly (e.g., through wires) or wirelessly. According to an embodiment, the interface **177** may include, for example, a high-definition multimedia interface (HDMI), a universal serial bus (USB) interface, a secure digital (SD) card interface, or an audio interface.

The connection terminal **178** may include a connector via which the electronic device **101** may be physically connected with the external electronic device (e.g., the electronic device **102**). According to an embodiment, the connection terminal **178** may include, for example, an HDMI connector, a USB connector, an SD card connector, or an audio connector (e.g., a headphone connector).

The haptic module **179** may convert an electrical signal into a mechanical stimulus (e.g., a vibration or a movement) or electrical stimulus which may be recognized by a user via his tactile sensation or kinesthetic sensation. According to an embodiment, the haptic module **179** may include, for example, a motor, a piezoelectric element, or an electric stimulator.

The camera module **180** may capture a still image or moving images. According to an embodiment, the camera module **180** may include one or more lenses, image sensors, image signal processors, or flashes.

The power management module **188** may manage power supplied to the electronic device **101**. According to one embodiment, the power management module **188** may be implemented as at least part of, for example, a power management integrated circuit (PMIC).

The battery **189** may supply power to at least one component of the electronic device **101**. According to an embodiment, the battery **189** may include, for example, a primary cell which is not rechargeable, a secondary cell which is rechargeable, or a fuel cell.

The communication module **190** may support establishing a direct (e.g., wired) communication channel or a wireless communication channel between the electronic device **101** and the external electronic device (e.g., the electronic device **102**, the electronic device **104**, or the server **108**) and performing communication via the established communication channel. The communication module **190** may include one or more communication processors that are operable independently from the processor **120** (e.g., an application processor (AP)) and supports a direct (e.g., wired) communication or a wireless communication. According to an embodiment, the communication module **190** may include a wireless communication module **192** (e.g., a cellular communication module, a short-range wireless communication module, or a global navigation satellite system (GNSS) communication module) or a wired communication module **194** (e.g., a local area network (LAN) communication module or a power line communication (PLC) module). A corresponding one of these communication modules may communicate with the external electronic device via the first network **198** (e.g., a short-range communication network, such as Bluetooth™, Wi-Fi direct, or infrared data association (IrDA)) or the second network **199** (e.g., a long-range communication network, such as a legacy cellular network, a fifth generation (5G) network, a next-generation communication network, the Internet, or a computer network (e.g., LAN or wide area network (WAN))). These various types of communication modules may be implemented as a single component (e.g., a single chip), or may be implemented as multi components (e.g., multi chips) separate from each other. The wireless communication module **192** may identify and authenticate the electronic device **101** in a communication network, such as the first network **198** or the second network **199**, using subscriber information (e.g., international mobile subscriber identity (IMSI)) stored in the subscriber identification module **196**.

The wireless communication module **192** may support a 5G network, after a 4G network, and next-generation communication technology, e.g., new radio (NR) access technology. The NR access technology may support enhanced mobile broadband (eMBB), massive machine type communications (mMTC), or ultra-reliable and low-latency communications (URLLC). The wireless communication module **192** may support a high-frequency band (e.g., the mmWave band) to achieve, e.g., a high data transmission rate. The wireless communication module **192** may support various technologies for securing performance on a high-frequency band, such as, e.g., beamforming, massive multiple-input and multiple-output (massive MIMO), full dimensional MIMO (FD-MIMO), array antenna, analog beam-forming, or large-scale antenna. The wireless communication module **192** may support various requirements specified in the electronic device **101**, an external electronic device (e.g., the electronic device **104**), or a network system (e.g., the second network **199**). According to an embodiment, the wireless communication module **192** may support a peak data rate (e.g., 20 Gbps or more) for implementing eMBB, loss coverage (e.g., 164 dB or less) for implementing mMTC, or U-plane latency (e.g., 0.5 ms or less for each of downlink (DL) and uplink (UL), or a round trip of 1 ms or less) for implementing URLLC.

The antenna module **197** may transmit or receive a signal or power to or from the outside (e.g., the external electronic device) of the electronic device **101**. According to an embodiment, the antenna module **197** may include an antenna including a radiating element composed of a conductive material or a conductive pattern formed in or on a substrate (e.g., a printed circuit board (PCB)). According to an embodiment, the antenna module **197** may include a plurality of antennas (e.g., array antennas). In such a case, at least one antenna appropriate for a communication scheme used in the communication network, such as the first network **198** or the second network **199**, may be selected, for example, by the communication module **190** (e.g., the wireless communication module **192**) from the plurality of antennas. The signal or the power may then be transmitted or received between the communication module **190** and the external electronic device via the selected at least one antenna. According to an embodiment, another component (e.g., a radio frequency integrated circuit (RFIC)) other than the radiating element may be additionally formed as part of the antenna module **197**.

According to various embodiments, the antenna module **197** may form mmWave antenna module. According to an embodiment, the mmWave antenna module may include a printed circuit board, a RFIC disposed on a first surface (e.g., the bottom surface) of the printed circuit board, or adjacent to the first surface and capable of supporting a designated high-frequency band (e.g., an mmWave band), and a plurality of antennas (e.g., array antennas) disposed on a second surface (e.g., the top or a side surface) of the printed circuit board, or adjacent to the second surface and capable of transmitting or receiving signals of the designated high-frequency band.

At least some of the above-described components may be coupled mutually and communicate signals (e.g., commands or data) therebetween via an inter-peripheral communication scheme (e.g., a bus, general purpose input and output (GPIO), serial peripheral interface (SPI), or mobile industry processor interface (MIPI)).

According to an embodiment, commands or data may be transmitted or received between the electronic device **101** and the external electronic device **104** via the server **108** coupled with the second network **199**. Each of the electronic devices **102** or **104** may be a device of a same type as, or a different type, from the electronic device **101**. According to an embodiment, all or some of operations to be executed at the electronic device **101** may be executed at one or more of the external electronic devices **102**, **104**, or **108**. For example, if the electronic device **101** should perform a function or a service automatically, or in response to a request from a user or another device, the electronic device **101**, instead of, or in addition to, executing the function or the service, may request the one or more external electronic devices to perform at least part of the function or the service. The one or more external electronic devices receiving the request may perform the at least part of the function or the service requested, or an additional function or an additional service related to the request, and transfer an outcome of the performing to the electronic device **101**. The electronic device **101** may provide the outcome, with or without further processing of the outcome, as at least part of a reply to the request. To that end, a cloud computing, distributed computing, mobile edge computing (MEC), or client-server computing technology may be used, for example. The electronic device **101** may provide ultra-low-latency services using, e.g., distributed computing or mobile edge computing. In another embodiment, the external electronic device **104** may include an internet-of-things (IoT) device. The server **108** may be an intelligent server using machine learning and/or a neural network. According to an embodiment, the external electronic device **104** or the server **108** may be included in the second network **199**. The electronic device **101** may be applied to intelligent services (e.g., smart home, smart city, smart car, or healthcare) based on 5G communication technology or IoT-related technology.

FIG. **2** is a block diagram **200** illustrating the display module **160** according to various embodiments.

Referring to FIG. **2**, the display module **160** may include a display **210** and a display driver integrated circuit (DDI) **230** to control the display **210**. The DDI **230** may include an interface module **231**, memory **233** (e.g., buffer memory), an image processing module **235**, or a mapping module **237**. The DDI **230** may receive image information that contains image data or an image control signal corresponding to a command to control the image data from another component of the electronic device **101** via the interface module **231**. For example, according to an embodiment, the image information may be received from the processor **120** (e.g., the main processor **121** (e.g., an application processor)) or the auxiliary processor **123** (e.g., a graphics processing unit) operated independently from the function of the main processor **121**. The DDI **230** may communicate, for example, with touch circuitry **1250** or the sensor module **176** via the interface module **231**. The DDI **230** may also store at least part of the received image information in the memory **233**, for example, on a frame by frame basis. The image processing module **235** may perform pre-processing or post-processing (e.g., adjustment of resolution, brightness, or size) with respect to at least part of the image data. According to an embodiment, the pre-processing or post-processing may be performed, for example, based at least in part on one or more characteristics of the image data or one or more characteristics of the display **210**. The mapping module **237** may generate a voltage value or a current value corresponding to the image data pre-processed or post-processed by the image processing module **235**. According to an embodiment, the generating of the voltage value or current value may be performed, for example, based at least in part on one or more attributes of the pixels (e.g., an array, such as an RGB stripe or a pentile structure, of the pixels, or the size of each subpixel). At least some pixels of the display **210** may be driven, for example, based at least in part on the voltage value or the current value such that visual information (e.g., a text, an image, or an icon) corresponding to the image data may be displayed via the display **210**.

According to an embodiment, the display module **160** may further include the touch circuitry **250**. The touch circuitry **250** may include a touch sensor **251** and a touch sensor IC **253** to control the touch sensor **251**. The touch sensor IC **253** may control the touch sensor **251** to sense a touch input or a hovering input with respect to a certain position on the display **210**. To achieve this, for example, the touch sensor **251** may detect (e.g., measure) a change in a signal (e.g., a voltage, a quantity of light, a resistance, or a quantity of one or more electric charges) corresponding to the certain position on the display **210**. The touch circuitry **250** may provide input information (e.g., a position, an area, a pressure, or a time) indicative of the touch input or the hovering input detected via the touch sensor **251** to the processor **120**. According to an embodiment, at least part (e.g., the touch sensor IC **253**) of the touch circuitry **250** may be formed as part of the display **210** or the DDI **230**, or as part of another component (e.g., the auxiliary processor **123**) disposed outside the display module **160**.

According to an embodiment, the display module **160** may further include at least one sensor (e.g., a fingerprint sensor, an iris sensor, a pressure sensor, or an illuminance sensor) of the sensor module **176** or a control circuit for the at least one sensor. In such a case, the at least one sensor or the control circuit for the at least one sensor may be embedded in one portion of a component (e.g., the display **210**, the DDI **230**, or the touch circuitry **1250**)) of the display module **160**. For example, when the sensor module **176** embedded in the display module **160** includes a biometric sensor (e.g., a fingerprint sensor), the biometric sensor may obtain biometric information (e.g., a fingerprint image) corresponding to a touch input received via a portion of the display **210**. As another example, when the sensor module **176** embedded in the display module **160** includes a pressure sensor, the pressure sensor may obtain pressure information corresponding to a touch input received via a partial or whole area of the display **210**. According to an embodiment, the touch sensor **251** or the sensor module **176** may be disposed between pixels in a pixel layer of the display **210**, or over or under the pixel layer.

FIG. **3**A is a perspective view **300** of an electronic device **301** in a closed state according to an embodiment of the disclosure. FIG. **3**B is a perspective view **350** of the electronic device **301** in an open state according to an embodiment of the disclosure.

Referring to FIGS. **3**A and **3**B, an electronic device **301** (e.g., an electronic device **101** in FIG. **1**) may include a housing (or a housing structure) **310**, a flexible display **330**, a cylindrical roller **321**, and/or a battery **323**.

According to an embodiment, at least a portion of the flexible display **330** may be accommodated in the internal space of the housing **310** in a state of being rolled in a circular shape. The flexible display **330** may be referred to as, for example, a rollable display.

The closed state of the electronic device **301** illustrated in FIG. **3**A is, for example, the state in which the flexible display **330** is maximally moved such that the flexible display **330** is not introduced into the internal space of the housing **310** anymore, and may be referred to as a state in which a screen (e.g., a display area or an active area) visible to the outside is contracted. In an embodiment, the screen visible to the outside in the closed state of the electronic device **301** may not be substantially provided.

In another embodiment, although not shown, the electronic device **301** may further include a display (not shown) disposed inside the housing **310**. For example, the flexible display includes a first flexible display **330** (e.g., a main display) that may be introduced into the internal space of the housing **310** and a second flexible display (not shown) disposed to correspond to the shape of the housing **310** (e.g., a sub display). When the electronic device **301** further includes a second flexible display disposed to correspond to the shape of the housing **310**, the electronic device **301** may be implemented to form a screen for displaying visual information through the second flexible display in the closed state of the electronic device **301**.

The open state of the electronic device **301** illustrated in FIG. **3**B is, for example, the state in which the flexible display **330** is maximally moved such that the flexible display **330** is not pulled out of the housing **310** anymore, and may be referred to as the state in which the screen S is expanded. Although not illustrated, the electronic device **301** may be in an intermediate state between the closed state in FIG. **3**A and the open state in FIG. **3**B.

At least a portion of the flexible display **330** may be introduced into the internal space of the housing **310** while being rolled in a circle around, for example, the rotation axis C. In an embodiment, the housing **310** may include a first surface **311** and a second surface **312** located apart from each other in a direction in which the rotation axis C extends (e.g., the y-axis direction). The first surface **311** may be oriented in a first direction (e.g., the +y-axis direction), and the second surface **312** may be oriented in a second direction (e.g., the −y-axis direction) opposite to the first direction. The housing **310** may include a third surface **313** (e.g., a lateral surface or a side surface) that surrounds the space between the first surface **311** and the second surface **312**. The housing **310** may include an opening **340** located in the third surface **313**, and the flexible display **330** may be introduced into the interior space of the housing **310** through the opening **340** or may be pulled out to the outside of the housing **310**. In some embodiments, the housing **310** may refer to a structure defining at least a portion of the first surface **311**, the second surface **312**, and the third surface **313**.

According to an embodiment, the cylindrical roller **321** may be located inside the housing **310** to be rotatable about the rotation axis C. During the state change of the electronic device **301** (e.g., switching between the closed state in FIG. **3**A and the open state in FIG. **3**B), there may be switching between a movement of the flexible display **330** and a rotational motion of the cylindrical roller **321**. For example, when the electronic device **301** is switched from the open state to the closed state, at least a portion of the flexible display **330** may be introduced into the internal space of the housing **310** while being rolled around the cylindrical outer surface of the cylindrical roller **321** rotating about the rotation axis C.

In an embodiment, referring to the closed state in FIG. **3**A, the battery **323** may be located in the internal space in which the flexible display **330** is rolled. The cylindrical roller **321** may include a cylindrical outer surface on which the flexible display **330** may be positioned in a rolled state, and a cylindrical inner surface located opposite to the cylindrical outer surface. The cylindrical roller **321** may include, for example, a hollow extending from a first opening at one side to a second opening at the other side. In some embodiments, the electronic device **301** or the cylindrical roller **321** may further include a cover (or a cover member) configured to at least partially cover the first opening or the second opening. The cylindrical outer surface of the cylindrical roller **321** may be a circular outer peripheral surface (e.g., a cylindrical surface) spaced apart from the rotation axis C by a corresponding radius. The battery **323** may be located in the internal space (e.g., the hollow) of the cylindrical roller **321** which is a space defined by the cylindrical inner surface of the cylindrical roller **321**. In some embodiments, the cylindrical roller **321** may be referred to by various other terms, such as a hollow cylinder or a cylindrical shell. The cylindrical inner surface may have a shape corresponding to the internal space of the cylindrical roller **321** in which the battery **323** is accommodated. For example, the battery **323** may have a cylindrical shape, and the cylindrical inner surface of the cylindrical roller **321** may be parallel to the cylindrical outer surface of the battery **323** or the cylindrical outer surface of the cylindrical roller **321**. The cylindrical inner surface of the cylindrical roller **321** is not limited to a circular surface, and may be provided in various other shapes capable of supporting the battery **323**.

According to an embodiment, during the state change of the electronic device **301** (e.g., switching between the closed state in FIG. **3**A and the open state in FIG. **3**B), the battery **323** may be rotated together with the cylindrical roller **321**. For example, the battery **323** may be fitted into the internal space of the cylindrical roller **321**, and a rotating body **320** including the cylindrical roller **321** and the battery **323** may

be provided. In an embodiment, the rotating body **320** including the cylindrical roller **321** and the battery **323** may be implemented by balancing the weight about the rotation axis C. This makes it possible to suppress occurrence of vibration of the electronic device **301** when the rotating body **320** including the cylindrical roller **321** and the battery **323** is rotated about the rotation axis C during the state change (e.g., switching between the closed state in FIG. **3**A and the open state in FIG. **3**B) of the electronic device **301**.

FIGS. **3**A and **3**B according to various embodiments, it is described that at least a portion of the flexible display **330** may be introduced into the internal space of the housing **310** while being rolled in a circle about the rotation axis C, but is not limited thereto. For example, according to the characteristics of the flexible display **330**, it may be rolled by itself without a separate axis.

FIG. **4**A is a front perspective view illustrating an electronic device **400** in a closed state according to an embodiment. FIG. **4**B is a front perspective view illustrating an electronic device **400** in an open state according to an embodiment.

According to various embodiments, the electronic device has been described as the electronic device **301** having a rollable form factor shown in FIGS. **3**A and **3**B, but is not limited thereto. For example, the electronic device may include the electronic device **400** of a slideable form factor as shown in FIGS. **4**A and **4**B.

According to various embodiments, the electronic device **400** of FIGS. **4**A and **4**B may include the electronic device **101** of FIG. **1**.

Referring to FIGS. **4**A and **4**B, in an embodiment, the electronic device **400** may be implemented to expand a screen **4301** in a sliding manner. For example, the screen **4301** may be an externally visible area in the flexible display **430** (e.g., the flexible display **330** of FIGS. **3**A and **3**B).

FIG. **4**A illustrate the electronic device **400** in a state in which the screen **4301** is not expanded, and FIG. **4**B illustrate the electronic device **400** in a state in which the screen **4301** is expanded. A state in which the screen **4301** is not expanded is a state in which a sliding plate **420** for a sliding motion of the flexible display **430** is not slide-out, and may be referred to as a ‘closed state’ hereinafter. The expanded state of the screen **4301** is a state in which the screen **4301** is no longer expanded, i.e., is expanded to the maximum by sliding out of the sliding plate **420** and may be referred to as an ‘open state’ hereinafter.

According to an embodiment, slide-out may refer to at least a partial movement of the sliding plate **420** in a first direction (e.g., +x axis direction) when the electronic device **400** is switched from the closed state to the open state. According to various embodiments, the open state may be defined as a state in which the screen **4301** is expanded compared to the closed state, and screens of various sizes may be provided according to a moving position of the sliding plate **420**.

According to various embodiments, the state of the electronic device **400** may include an intermediate state. The intermediated state may refer to a state between the closed state of FIG. **4**B and the open state of FIG. **4**A. The screen **4301** may include an active area of the flexible display **430** that can output an image by visual exposure, and the electronic device **400** may adjust the active area according to a movement of the sliding plate **420** or a movement of the flexible display **430**. In the following description, the open state may indicate a state in which the screen **4301** is maximally expanded. In some embodiments, the flexible display **430** disposed to perform a sliding motion in the electronic device **400** of FIG. **4**A to provide the screen **4301** may be referred to as a 'slide-out display' or an 'expandable display'.

According to an embodiment, the electronic device **400** may include a sliding structure related to the flexible display **430**. For example, when the flexible display **430** is moved to a preset distance by an external force, the flexible display **430** may be switched from a closed state to an open state or from an open state to a closed state without any further external force due to an elastic structure included in the sliding structure (e.g., semi-automatic slide motion).

According to some embodiments, when a signal is generated through an input device included in the electronic device **400**, the electronic device **400** may be switched from a closed state to an open state or from an open state to a closed state by a driving device such as a motor connected to the flexible display **430**, For example, when a signal is generated through a hardware button or a software button provided through a screen, the electronic device **400** may be switched from a closed state to an open state or from an open state to a closed state.

According to various embodiments, when a signal is generated from various sensors such as a pressure sensor, the electronic device **400** may be switched from a closed state to an open state or from an open state to a closed state. For example, when carrying or holding the electronic device **400** by hand, a squeeze gesture in which a part of the hand (e.g., a palm or a finger of the hand) presses within a specified section of the electronic device **400** may be detected by the sensor, and the electronic device **400** may be switched from a closed state to an open state or from an open state to a closed state corresponding thereto.

According to an embodiment, the flexible display **430** may include a bendable section (②) (see FIG. **4**B). When the electronic device **400** is switched from a closed state to an open state, the bendable section (②) may include an extended portion of the screen **4301**. When the electronic device **400** is switched from the closed state to the open state, the bendable section (②) may be drawn from the internal space of the electronic device **400** by sliding; thus, the screen **4301** may be expanded. When the electronic device **400** is switched from the open state to the closed state, at least a portion of the bendable section (②) may be introduced into the internal space of the electronic device **400** by sliding; thus, the screen **4301** may be reduced. When the electronic device **400** is switched from the open state to the closed state, at least a portion of the bendable section (②) may be moved to the internal space of the electronic device **400** while being bent. For example, the flexible display **430** may include a flexible substrate (e.g., plastic substrate) made of a polymer material including polyimide (PI) or polyester (PET).

According to an embodiment, the electronic device **400** may include a housing **410**, a sliding plate **420**, or a flexible display **430**.

The housing (or case) **410** may include, for example, a back cover (not illustrated), a first side cover **413**, or a second side cover **414**. The back cover (not illustrated), the first side cover **413**, or the second side cover **414** may be connected to a support member (not illustrated) positioned inside the electronic device **400**, and form at least a portion of an external shape of the electronic device **400**.

The back cover (not illustrated) may form, for example, at least a portion of a rear surface (not illustrated) of the electronic device **400**. In an embodiment, the back cover (not illustrated) may be substantially opaque. For example, the back cover (not illustrated) may be made of coated or tinted glass, ceramic, polymer, metal (e.g., aluminum, stainless steel (STS), or magnesium), or a combination of at least two of the above materials. According to some embodiments, in a state in which the bendable section ② of the flexible display **430** is introduced into the inner space of the housing **410** (e.g., closed state), at least a portion of the bendable section ② may be disposed to be visible from the outside through the back cover (not illustrated). In this case, the back cover (not illustrated) may be made of a transparent material and/or a translucent material.

According to an embodiment, the first side cover **413** and the second side cover **414** may be positioned opposite to each other. For example, the first side cover **413** and the second side cover **414** may be positioned opposite to each other with the flexible display **430** interposed therebetween in a second direction (e.g., y axis direction) orthogonal to the first direction (e.g., +x axis direction) of slide out of the sliding plate **420**. The first side cover **413** may form at least a portion of the first side surface (not illustrated) of the electronic device **400**, and the second side cover **414** may form at least a portion of the second side **414***a* of the electron device **200** facing in a direction opposite to the first side surface (not illustrated). The first side cover **413** may include a first edge portion **413***b* extended from an edge of the first side surface (not illustrated). For example, the first edge portion **413***b* may form at least a portion of one side bezel of the electronic device **400**. The second side cover **414** may include a second edge portion **414***b* extended from an edge of the second side surface **414***a*. For example, the second edge portion **414***b* may form at least a portion of the other side bezel of the electronic device **400**. According to an embodiment, in the closed state of FIG. **4**A, a surface of the first edge portion **413***b*, a surface of the second edge portion **414***b*, and a surface of the sliding plate **420** may be smoothly connected to form one side curved portion (not illustrated) corresponding to the first curved portion **430***b* side of the screen **4301**. According to various embodiments, the surface of the first edge portion **413***b* or the surface of the second edge portion **414***b* may include the other side curved portion (not illustrated) corresponding to the second curved portion **430***c* side of the screen **4301** positioned at the opposite side of the first curved portion **430***b*.

According to an embodiment, the sliding plate **420** may perform a sliding motion on a support member (not illustrated) positioned inside the electronic device **400**. At least a portion of the flexible display **430** may be disposed in the sliding plate **420**, and the closed state of FIG. **4**A or the open state of FIG. **4**B may be formed based on a position of the sliding plate **420** on the support member. According to an embodiment, the flexible display **430** may be attached to the sliding plate **420** through an adhesive member (not illustrated). According to an embodiment, the adhesive member may include a thermally responsive adhesive member, a photoreactive adhesive member, a general adhesive, and/or a double-sided tape. According to some embodiments, the flexible display **430** may be inserted into a recess formed in the sliding plate **420** in a sliding manner to be disposed at and fixed to the sliding plate **420**. The sliding plate **420** may serve to support at least a portion of the flexible display **430**, and be referred to as a display support structure in some embodiments.

According to an embodiment, the sliding plate **420** may include a third edge portion **420***b* that forms an outer surface of the electronic device **400** (e.g., a surface exposed to the outside to form an external shape of the electronic device **400**). For example, the third edge portion **420***b* may form a bezel around the screen together with the first edge portion

413*b* and the second edge portion 414*b* in the closed state of FIG. 4A. The third edge portion 420*b* may be extended in the second direction (e.g., y-axis direction) so as to connect one end portion of the first side cover 413 and one end portion of the second side cover 414 in the closed state. For example, in the closed state of FIG. 4A, a surface of the third edge portion 420*b* may be smoothly connected to a surface of the first edge portion 413*b* and/or a surface of the second edge portion 414*b*.

According to an embodiment, due to slide out of the sliding plate 420, while at least a portion of the bendable section ② comes out from the inside of the electronic device 400, a state (e.g., open state) in which the screen 4301 is expanded may be provided, as illustrated in FIG. 4B.

According to an embodiment, in the closed state of FIG. 4A, the screen 4301 may include a flat portion 430*a* and a first curved portion 430*b* and/or a second curved portion 430*c* positioned in opposite sides with the flat portion 430*a* interposed therebetween. For example, the first curved portion 430*b* and the second curved portion 430*c* may be substantially symmetrical with the flat portion 430*a* interposed therebetween. When the electronic device 400 is switched from the closed state of FIG. 4A to the open state of FIG. 4B, the flat portion 430*a* may be expanded. For example, a partial area of the bendable section ② forming the second curved portion 430*c* in the closed state of FIG. 4A may be included in an expanded flat portion 430*a* when the electronic device 400 is switched from the closed state of FIG. 4A to the open state of FIG. 4B and be formed as another area of the bendable section ②.

According to an embodiment, the electronic device 400 may include an opening (not illustrated) for entering or withdrawing the bendable section ②, and/or a pulley (not illustrated) positioned in the opening. The pulley may be positioned to correspond to the bendable section ②, and a movement of the bendable section ② and a direction of movement thereof may be guided through a rotation of the pulley in a switch between the closed state of FIG. 4A and the open state of FIG. 4B. The first curved portion 430*b* may be formed to correspond to a curved surface formed in one surface of the sliding plate 420. The second curved portion 430*c* may be formed by a portion corresponding to the curved surface of the pulley in the bendable section ②. The first curved portion 430*b* may be positioned opposite to the second curved portion 430*c* in the closed state or the open state of the electronic device 400 to improve an aesthetic impression of the screen 4301. According to some embodiments, the flat portion 430*a* may be implemented in an expanded form without the first curved portion 430*b*.

According to an embodiment, the flexible display 430 may further include a touch sensing circuit (e.g., touch sensor). According to various embodiments (not illustrated), the flexible display 430 may be coupled to a pressure sensor capable of measuring the intensity (pressure) of a touch, and/or a digitizer that detects a magnetic field type pen input device (e.g., stylus pen) or may be disposed adjacent thereto. For example, the digitizer may include a coil member disposed on a dielectric substrate so as to detect a resonance frequency of an electromagnetic induction method applied from the pen input device.

According to an embodiment, the electronic device 400 may include a microphone hole 451 (e.g., the input module 150 of FIG. 1), a speaker hole 452 (e.g., the sound output module 155 of FIG. 1), and/or a connector hole 453 (e.g., the connection terminal 178 of FIG. 1). In some embodiments, the electronic device 400 may omit at least one of the components or additionally include other components.

The microphone hole 451 may be formed, for example, in at least a portion of the second side surface 414*a* corresponding to a microphone (not illustrated) positioned inside the electronic device 400. A position of the microphone hole 451 is not limited to the embodiment of FIG. 4A and may vary. According to some embodiments, the electronic device 400 may include a plurality of microphones capable of detecting a direction of a sound.

The speaker hole 452 may be formed, for example, in at least a portion of the second side surface 414*a* corresponding to a speaker positioned inside the electronic device 400. A position of the speaker hole 452 is not limited to the embodiment of FIG. 4A and may vary. According to various embodiments, the electronic device 400 may include a receiver hole for a call. In some embodiments, the microphone hole 451 and the speaker hole 452 may be implemented as one hole, or the speaker hole 452 may be omitted as in a piezo speaker.

The connector hole 453 may be formed, for example, in at least a portion of the second side surface 414*a* corresponding to a connector (e.g., USB connector) positioned inside the electronic device 400. The electronic device 400 may transfer and/or receive power and/or data to and/or from an external electronic device electrically connected to the connector through the connector hole 453. A position of the connector hole 453 is not limited to the embodiment of FIG. 4A and may vary.

According to various embodiments (not illustrated), the electronic device 400 may further include a camera module (e.g., front camera) that generates an image signal based on light received through one surface (e.g., a front surface 400A) of the electronic device 400 placed in a direction in which the screen 4301 faces. For example, the camera module (e.g., front camera) (not illustrated) may be aligned with an opening (e.g., through hole or notch) formed in the flexible display 430 to be positioned inside the housing 410. The camera module (e.g., front camera) (not illustrated) may receive light through the opening and a partial area of a transparent cover overlapped with the opening to generate an image signal. The transparent cover may serve to protect the flexible display 430 from the outside, and include, for example, a material such as polyimide or ultra-thin glass (UTG).

According to some embodiments, the camera module (e.g., front camera) (not illustrated) may be disposed at the bottom of at least a portion of the screen 4301 of the flexible display 430, and the camera module (e.g., front camera) (not illustrated) may perform a related function (e.g., image taking) without visually distinguishing (or exposing) a position thereof. In this case, for example, when viewed from above the screen 4301 (e.g., when viewed in a −z axis direction), the camera module (e.g., front camera) (not illustrated) may be disposed to overlap at least a portion of the screen 4301 and obtain an image of an external subject while being not exposed to the outside.

According to various embodiments (not illustrated), the electronic device 400 may further include a key input device (e.g., the input module 150 of FIG. 1). The key input device may be positioned, for example, at the first side surface (not illustrated) of the electronic device 400 formed by the first side cover 413. In some embodiments (not illustrated), the key input device may include at least one sensor module.

According to various embodiments (not illustrated), the electronic device 400 may include various sensor modules (e.g., the sensor module 176 of FIG. 1). The sensor module may generate an electrical signal or data value corresponding to an internal operating state or an external environmental state of the electronic device **400**. For example (not illustrated), the sensor module may include a proximity sensor that generates a signal regarding proximity of an external object based on light received through the front surface **400**A of the electronic device **400** placed in a direction in which the screen **4301** faces. For another example (not illustrated), the sensor module may include various biometric sensors such as a fingerprint sensor or a heart rate monitor (HRM) sensor for detecting biometric information based on light received through the front surface **400**A or the rear surface (not illustrated) of the electronic device **400**. The electronic device **400** may include various other sensor modules, for example, at least one of a gesture sensor, a gyro sensor, an atmospheric sensor, a magnetic sensor, an acceleration sensor, a grip sensor, a color sensor, an infrared (IR) sensor, a biometric sensor, a temperature sensor, a humidity sensor, or an illuminance sensor.

FIG. **5**A is a view **500** of multiple electrodes constituting a touch circuit included in a flexible display **330** or **430** according to various embodiments.

Referring to FIG. **5**A, the flexible display (e.g., the flexible display **330** in FIG. **3**A and FIG. **3**B, or the flexible display **430** in FIG. **4**A and FIG. **4**B) may include a touch circuit (e.g., the touch circuit **250** in FIG. **2**) (or a touch sensor circuit (e.g., the touch sensor integrated circuit (IC) **253** in FIG. **2**). For example, the touch circuit **250** may include a transmitter (TX) **510** including multiple first electrode lines (e.g., multiple driving electrodes) and a receiver (RX) **520** including multiple second electrode lines (e.g., multiple reception electrodes).

In an embodiment, an electronic device (e.g., the electronic device **301** in FIG. **3**A and FIG. **3**B, or the electronic device **400** in FIG. **4**A and FIG. **4**B) may apply a driving signal through the multiple first electrode lines (e.g., the multiple driving electrodes) constituting the touch circuit **250** and receive the applied driving signal through the multiple second electrode lines (e.g., the multiple reception electrodes).

In an embodiment, the electronic device **301** or **400** may identify a capacitance value based on the driving signal received through the multiple first electrode lines. The electronic device **301** or **400** may determine a folded area (e.g., a bending area) of the flexible display **330** or **430** based on the capacitance value. The electronic device **301** or **400** may determine (e.g., configure or set) an activation area of the flexible display **330** or **430** based on the determined folded area (e.g., a bending area). For example, the electronic device **301** or **400** may determine (e.g., configure or set) the configured folded area (e.g., a bending area) as a deactivation area. The electronic device **301** or **400** may determine (e.g., configure or set) an area other than the configured deactivation area of the display area of the flexible display **330** or **430** as an activation area. For another example, the electronic device **301** or **400** may additionally determine (e.g., configure or set) an area inserted into the housing **310** or **410** or covered by the housing **310** or **410** other than the configured folded area of the display area as a deactivation area. The electronic device **301** or **400** may determine an area excluding the deactivation area of the display area as an activation area. For example, the area inserted into the housing **310** or **410** may be determined based on a configuration value (e.g., a specified distance value from one end of the folded area) stored in a memory (e.g., the memory **130** in FIG. **1**) of the electronic device **301** or **400** and/or a state (e.g., an intermediate state) of the electronic device **301** or **400** detected through a sensor (e.g., a Hall sensor).

In various embodiments, the configuration of the deactivation area may be performed by turning off an area of the flexible display **330** or **430** configured as the deactivation area or may be performed to prevent malfunction of a touch input by ignoring a touch coordinate occurring in an area of the flexible display **330** or **430** configured as the deactivation area.

FIG. **5**B a view **550** illustrating an image formed based on raw data for a capacitance value of a flexible display **330** of an electronic device **301** according to various embodiments.

FIG. **5**B according to various embodiments is a view **550** explaining a method for identifying a capacitance value based on raw data of the flexible display **330** in the electronic device **301** having a form factor of a rollable form shown in FIG. **3**A and FIG. **3**B.

In FIG. **5**B according to various embodiments, the x-axis **520** may indicate the receiver (RX) **520** including the multiple second electrode lines (e.g., the multiple reception electrodes), y-axis **510** may indicate the transmitter (TX) **510** including the multiple first electrode lines (e.g., the multiple driving electrodes), and z-axis **530** may indicate a capacitance for each of the multiple first electrode lines and the multiple second electrode lines.

Referring to FIG. **5**B, the electronic device **301** may identify a capacitance based on raw data for the display area of the flexible display **330**. For example, the electronic device **301** may analyze raw data for the display area and identify an area in which a capacitance change is detected, based on the analyzed raw data. In an embodiment the electronic device **301** may perform preprocessing (e.g., filtering and/or normalization) raw data.

In another embodiment, the electronic device **301** may perform image-processing for raw data for the display area of the flexible display **330**. The electronic device **301** may identify an area in which a capacitance is detected, based on the processed image.

In various embodiments below, it will be described that raw data for the display area of the flexible display **330** is image-processed and an area in which a capacitance is detected is identified based thereon. However, the disclosure is not limited thereto.

In an embodiment, the electronic device **301** may identify a capacitance change based on an image **555** with respect to raw data generated by performing image processing. By way of example, at least a portion of the flexible display **330** including a touch circuit may be overlappingly rolled into the inner space of the housing **310**, and the electronic device **301** may identify an area in which a capacitance change due to interference between overlapped touch panels is detected.

In an embodiment, the electronic device **301** may identify a folded area (e.g., a bending area) **560** of the flexible display **330** based on the image **555** with respect to the generated raw data and determine (e.g., configure or set) a deactivation area based on the identified folded area (e.g., a bending area) **560**. In an embodiment, the electronic device **301** may additionally determine (e.g., configure or set) an area of the display area of the flexible display **330**, which is not the folded area (e.g., a bending area) **560** but is inserted into the housing **310**, as a deactivation area.

In an embodiment, the electronic device **301** may determine (e.g., configure or set) an unfolded area **565** of the display area of the flexible display **330** excluding the deactivation area as an activation area.

In an embodiment, as shown in FIG. **5**B, the capacitance of the folded area **560** may have a value larger than that of the unfolded area **565**. For example, interference caused as at least a portion of the flexible display **330** is overlappingly rolled into the inner space of the housing **310** may allow the capacitance of the folded area **560** to have a value lager than that of the unfolded area **565**. By way of example, a charge amount acquired when the driving signal applied through the multiple first electrode lines (e.g., the multiple driving electrodes) of the transmitter **510** is received through the multiple second electrode lines constituting the folded area **560** may be more than a charge amount acquired when the driving signal is received through the multiple second electrode lines constituting the unfolded area.

FIG. **5**C is a view **580** illustrating an image formed based on raw data for a capacitance value of a flexible display **430** of an electronic device **400** according to various embodiments.

FIG. **5**C according to various embodiments is a view **580** explaining a method for identifying a capacitance value based on raw data of the flexible display **430** in the electronic device **400** having a form factor of a slidable form shown in FIG. **4**A and FIG. **4**B.

In FIG. **5**C according to various embodiments, the x-axis **520** may indicate the receiver (RX) **520** including the multiple second electrode lines (e.g., the multiple reception electrodes), y-axis **510** may indicate the transmitter (TX) **510** including the multiple first electrode lines (e.g., the multiple driving electrodes), and z-axis **530** may indicate a capacitance for each of the multiple first electrode lines and the multiple second electrode lines.

Referring to FIG. **5**C, the electronic device **400** may identify a capacitance based on raw data for the display area of the flexible display **430**. For example, the electronic device **400** may analyze raw data for the display area and identify an area in which a capacitance change is detected, based on the analyzed raw data.

In another embodiment, the electronic device **400** may perform image-processing for raw data for the display area of the flexible display **430**.

In various embodiments below, it will be described that raw data for the display area of the flexible display **430** is image-processed and an area in which a capacitance is detected is identified based thereon. However, the disclosure is not limited thereto.

In an embodiment, the electronic device **400** may identify a capacitance change based on an image **585** with respect to raw data generated by performing image processing. For example, at least a portion of the flexible display **430** including a touch circuit may be inserted into the inner space of the electronic device **400**. The electronic device **400** may detect a capacitance change due to interference between touch circuits in an overlapping area as at least a portion of the flexible display **430** is inserted into the inner space of the electronic device **400**.

In an embodiment, the electronic device **400** may identify a folded area (e.g., a bending area) of the flexible display **430** based on the image **585** with respect to the generated raw data and determine (e.g., configure or set) an activation area based on the identified folded area (e.g., a bending area). For example, the electronic device **400** may determine (e.g., configure or set) the identified folded area **591** (e.g., a bending area) as a deactivation area. The electronic device **400** may additionally determine (e.g., configure or set) an area of the display area of the flexible display **330**, which is not the folded area **591** (e.g., a bending area) but is an area **593** inserted into the housing **410**, as a deactivation area. The electronic device **400** may determine (e.g., configure or set) an area **595** (e.g., an area of the flexible display **430** withdrawn to the outside of the electronic device **400**) of the display area of the flexible display **430** excluding the deactivation area as an activation area.

In an embodiment, as shown in FIG. **5**C, the capacitance of the folded area **591** may have a value higher than those of an area **593** inserted into the inner space of the housing **410** and an area **595** of the flexible display **430** withdrawn to the outside of the electronic device **400**. For example, as at least a portion of the flexible display **330** is inserted into the inner space of the electronic device **400**, at least some areas **591** of the flexible display **430** may overlap each other, causing interference with each other. Accordingly, the capacitance of the at least some overlapping areas **591** of the flexible display **430** may have a value higher than those of an area **593** inserted into the housing **410** and the unfolded area **565** (e.g., an area of the flexible display **430** withdrawn to the outside of the electronic device **400**). By way of example, a charge amount acquired when the driving signal applied through the multiple first electrode lines (e.g., the multiple driving electrodes) of the transmitter **510** is received through the multiple second electrode lines constituting the folded area **591** may be more than a charge amount received through the multiple second electrode lines constituting the area **593** inserted into the housing **410** and a charge amount received through the multiple second electrode lines constituting the unfolded area **595** (e.g., an area of the flexible display **430** withdrawn to the outside of the electronic device **400**.

FIG. **6**A is a front view **600** of an electronic device **301** viewed from one side according to various embodiments. FIG. **6**B is an enlarged view **650** of a specific area **610** of the flexible display **330** of FIG. **6**A according to various embodiments.

According to various embodiments, FIG. **6**A may be a view illustrating the electronic device **301** viewed from the −y-axis direction to the +y-axis direction with reference to FIG. **3**A and FIG. **3**B.

Referring to FIG. **6**A, at least a portion **620** of the flexible display **330** (e.g., the flexible display **330** in FIG. **3**A and FIG. **3**B) of the electronic device **301** (e.g., the electronic device **301** in FIG. **3**A and FIG. **3**B) may be inserted into the inner space of the housing **310** (e.g., the housing **310** in FIG. **3**A and FIG. **3**B) while being rolled in a circle around a rotation axis (e.g., the rotation axis C in FIG. **3**A and FIG. **3**B), and at least another portion **630** of the flexible display **330** may be in a state of being withdrawn from the inner space of the housing **310**. In an embodiment, the area **620** of the flexible display **330** inserted into the inner space of the housing **310** may include an area **620***a* rolled in a circle around the rotation axis C and an area **620***b* which is not rolled in a circle but inserted into the housing **310**.

In an embodiment, the flexible display **330** may include a touch circuit (e.g., the touch circuit **250** in FIG. **2**). For example, the touch circuit may include a transmitter (TX) (e.g., the transmitter **510** in FIG. **5**A) including multiple first electrode lines (e.g., multiple driving electrodes) and a receiver (RX) (e.g., the receiver **520** in FIG. **5**A) including multiple second electrode lines (e.g., multiple reception electrodes).

In an embodiment, the electronic device **301** may apply a driving signal through the transmitter **510** (e.g., the multiple first electrode lines) constituting a touch panel included in the flexible display **330**. The electronic device **301** may acquire a driving signal applied from the transmitter **510** through the receiver **520** (e.g., the multiple second electrode lines) constituting the touch panel.

Referring to FIG. **6**B with respect to the specific area **610** of the at least a portion **620** of the flexible display **330** inserted into the inner space of the housing **310** according to various embodiments, a driving signal **651** applied through the transmitter **510** included in a first area **611** of the specific area **610** of the flexible display **330** may be received **653** through the receiver **520** included in a second area **613**. Depending on a degree by which the flexible display **330** is rolled into the inner space of the housing **310**, at least some areas **620** of the flexible display **330** may be rolled overlapping each other around a rotation axis (e.g., the rotation axis C in FIG. **3**A and FIG. **3**B). A capacitance value of the at least some areas **620** of the display area of the flexible display **330**, which are rolled overlapping each other may be larger than that of an area **630** (e.g., a display area of the flexible display **330** withdrawn to the outside of the housing **310**) which is not overlappingly rolled.

For example, due to interference caused as at least a portion of the flexible display **330** is overlappingly rolled into the inner space of the housing **310**, a capacitance value of the at least some overlappingly rolled areas **620***a* may be higher than those of an area **620***b* which is not rolled in circle but inserted into the housing **310** and the unfolded area **630**. For another example, a charge amount acquired when the driving signal applied through the multiple first electrode lines (e.g., the multiple driving electrodes) of the transmitter **510** is received through the multiple second electrode lines constituting the overlappingly rolled area **620***a* may be more than a charge amount acquired when the driving signal is received through the multiple second electrode lines constituting the area **620***b* which is not rolled in circle but inserted into the housing **310** and the unfolded area **630**.

In various embodiments, the electronic device **301** may determine an area **620** having a high capacitance value in the display area of the flexible display **330** as a folded area or a bending area. The electronic device **301** may determine an area **630** excluding the folded area (or a bending area) of the flexible display **330** as an activation area. In case that there is an area in a deactivation state in at least a portion of the determined activation area, the electronic device **301** may activate the corresponding area. The electronic device **301** may display visual information (e.g., a text, an image, and/or an icon) on the activation area of the flexible display **330**.

In an embodiment, the area **620** of the flexible display **330** may include an area **620***b* inserted into the housing **310** in addition to an area **620***a* rolled in a circle around the rotation axis C. The electronic device **301** may additionally determine (e.g., configure or set) the area **620***b* inserted into the housing **310** as a deactivation area. By way of example, the area **620***b* inserted into the housing **310** may be determined based on a configuration value (e.g., a specified distance value from one end of the folded area) stored in a memory (e.g., the memory **130** in FIG. **1**) of the electronic device **301** and/or a state (e.g., an intermediate state) of the electronic device **301** detected through a sensor (e.g., a Hall sensor).

In another embodiment, the electronic device **301** may identify a capacitance value based on raw data with respect to a capacitance value of the flexible display **330**. For example, the electronic device **301** may analyze raw data for the display area and identify an area in which a capacitance change is detected, based on the analyzed raw data. In an embodiment the electronic device **301** may perform preprocessing (e.g., filtering and/or normalization) raw data. However, without limitation thereto, the electronic device **301** may image-process raw data for the display area of the flexible display **330** and identify an area in which a capacitance change is detected, based on the processed image. Based on information of the display area in which a capacitance change is detected, the electronic device **301** may identify an operation state (e.g., a state of being withdrawn from the inner space of the housing **310** (e.g., a state of withdrawing to the outer space of the housing **310**) or a state of being inserted into the inner space of the housing **310**) of the flexible display **330** and/or the folded area of the flexible display **330** in real time.

Without limitation thereto, the electronic device **301** may analyze the raw data through machine learning. For example, the electronic device **301** may analyze a raw data change through machine learning and based on the raw data change, may identify an operation state (e.g., a state of being withdrawn from the inner space of the housing **310** (e.g., a state of withdrawing to the outer space of the housing **310**) or a state of being inserted into the inner space of the housing **310**) of the flexible display **330** and/or the folded area of the flexible display **330** in real time.

With respect to the configuration for determining an area of the flexible display **330** as a bending area based on a capacitance value according to various embodiments, various embodiments will be described with reference to FIG. **9** to FIG. **14** below.

FIG. **7** is a front view **700** of an electronic device **400** viewed from one side according to various embodiments.

According to various embodiments, FIG. **7** may be a view illustrating the electronic device **400** viewed from the −y-axis direction to the +y-axis direction with reference to FIG. **4**A and FIG. **4**B.

Referring to FIG. **7**, the flexible display **430** (e.g., the flexible display **430** in FIG. **4**A and FIG. **4**B) of the electronic device **400** (e.g., the electronic device **400** in FIG. **4**A and FIG. **4**B) may include a bendable section ②. The bendable section ② may include an extended portion of a screen **4301** when the electronic device **400** is converted from a closed state (e.g., the state of FIG. **4**A) into an open state (e.g., the state of FIG. **4**B). In case that the electronic device **400** is converted from the closed state into the open state, the bendable section ② may be slidably withdrawn to the outside of the electronic device **400** and as such, the screen **4301** may extend. In case that the electronic device **400** is converted from the open state into the closed state, at least a portion of the bendable section ② may be slidably inserted into the inner space of the electronic device **400** and as such, the screen **4301** may be reduced. In this case, at least another portion of the bendable section ②, for example, a second curved portion **430***c*, may be exposed to the outside.

In an embodiment, the electronic device **400** may include a pulley **710** disposed in the housing **410** to correspond to the bendable section ②. In case that the bendable section ② is inserted into the electronic device **400**, at least a portion **4302** of the bendable section ② may include a planar area **430***e* and a curved area **430***d* corresponding to the pulley **710**.

In an embodiment, the flexible display **430** may include a touch circuit (e.g., the touch circuit **250** in FIG. **2**). For example, the touch circuit may include a transmitter (TX) (e.g., the transmitter **510** in FIG. **5**A) including multiple first electrode lines (e.g., multiple driving electrodes) and a receiver (RX) (e.g., the receiver **520** in FIG. **5**A) including multiple second electrode lines (e.g., multiple reception electrodes).

In an embodiment, the electronic device **400** may apply a driving signal through the transmitter **510** (e.g., the multiple first electrode lines) constituting a touch circuit included in the flexible display **430**. The electronic device **400** may acquire a driving signal applied from the transmitter **510** through the receiver **520** (e.g., the multiple second electrode lines) constituting the touch circuit.

A driving signal applied through at least a portion of the flexible display **430** inserted into the inner space of the electronic device **400** according to various embodiments, for example, the transmitter **510** included in the bendable section ② may be received through the receiver **520** included in the bendable section ②.

In an embodiment, in case that at least a portion of the flexible display **430** is inserted into the inner space of the electronic device **400**, a capacitance value of a partial area **430***c* or **430***d* of the bendable section ② may be different from those of an area **430***a* or **430***b* of the flexible display **430** not inserted into the inner space of the electronic device **400** and an area **430***e* which is inserted into the inner space of the electronic device **400** but does not form a curved surface.

In an embodiment, based on that the capacitance value of the partial area **430***c* or **430***d* of the bendable section ② of the flexible display **430** inserted into the inner space of the electronic device **400** is different from those of the area **430***a* or **430***b* of the flexible display **430** not inserted into the inner space of the electronic device **400** and the area **430***e* which is inserted into the inner space of the electronic device **400** but does not form a curved surface, the electronic device **400** may recognize that each area **430***a*, **430***b*, **430***c*, **430***d*, or **430***e* of the flexible display **430** is in a different state (e.g., a rolled state or unfolded state). That is, based on that each area **430***a*, **430***b*, **430***c*, **430***d*, or **430***e* of the flexible display has a different capacitance value, the electronic device **400** may distinguish a folded area and a planar area.

For example, due to interference as at least a portion of the flexible display **430** is inserted into the inner space of the electronic device **400**, a capacitance of at least some areas **430***c* and **430***d* overlapping each other may be different from those of an area **430***a* or **430***b* of the flexible display **430** not inserted into the inner space of the electronic device **400** and an area **430***e* which is inserted into the inner space of the electronic device **400** but does not form a curved surface. For example, a charge amount acquired when the driving signal applied through the multiple first electrode lines (e.g., the multiple driving electrodes) of the transmitter **510** is received through the multiple second electrode lines constituting the at least some areas **430***c* and **430***d* overlapping each other may be different from a charge amount received through the multiple second electrode lines constituting the area **430***a* or **430***b* of the flexible display **430** not inserted into the inner space of the electronic device **400** and the area **430***e* which is inserted into the inner space of the electronic device **400** but does not form a curved surface.

FIG. **8** is a block diagram **800** illustrating an electronic device **801** according to various embodiments.

Referring to FIG. **8**, the electronic device **801** (e.g., the electronic device **101** in FIG. **1**, the electronic device **301** in FIG. **3**A and FIG. **3**B, or the electronic device **400** in FIG. **4**A and FIG. **4**B) may include a memory **810** (e.g., the memory **130** in FIG. **1**), a sensor circuit **820** (e.g., the sensor module **176** in FIG. **1**), a flexible display **830** (e.g., the display module **160** in FIG. **1**, the flexible display **330** in FIG. **3**A and FIG. **3**B, or the flexible display **430** in FIG. **4**A and FIG. **4**B), a touch controller **835**, and/or a processor **840** (e.g., the processor **120** in FIG. **1**).

According to various embodiments of the disclosure, the memory **810** (e.g., the memory **130** in FIG. **1**) may store instructions for identifying a state (e.g., a closed state, an open state, or an intermediate state) and/or state conversion (e.g., initiation of an opening operation or initiation of a closing operation) of the electronic device **801**. For example, the memory **810** may store instructions configured to identify the closed state, the open state, or conversion between the closed state and the open state of the electronic device **801** by using at least one sensor included in the sensor circuit **820**. For another example, the memory may store instructions configured to identify the closed state, the open state, or conversion between the closed state and the open state of the electronic device **801** by using the touch circuit **833** included in the flexible display **830** and there is no limitation to a method for identifying the state and/or the state conversion of the electronic device **801**.

In another embodiment, the memory **810** may store instructions for identifying a capacitance value with respect to the display area of the flexible display **830**. For example, a driving signal applied through the multiple TX electrodes of the touch circuit **833** may be acquired through the multiple RX electrodes of the touch circuit **833** and based thereon, the memory may store instructions for identifying a capacitance value.

In an embodiment, the memory **810** may store instructions for determining (e.g., configure or set) a deactivation area and an activation area of the display area of the flexible display **830** based on the capacitance value. For example, the memory **810** may store instructions for determining (e.g., configure or set) a folded area corresponding to the deactivation area of the display area and/or an area inserted into the housing **310** or **410** (e.g., the electronic device **801**).

According to various embodiments of the disclosure, the sensor circuit **820** (e.g., the sensor module **176** in FIG. **1**) may measure a physical quantity or detect an operation state of the electronic device **801** and generate an electrical signal or a data value corresponding thereto. In an embodiment, the sensor circuit **820** may identify a closed state, an open state, or conversion (e.g., initiation of an opening operation or initiation of a closing operation) between the closed state and the open state of the electronic device **801** by using a magnetic sensor (or a Hall IC).

According to various embodiments of the disclosure, the flexible display **830** (e.g., the display module **160** in FIG. **1**, the flexible display **330** in FIG. **3**A and FIG. **3**B, or the flexible display **430** in FIG. **4**A and FIG. **4**B) may be configured to have an integrated form including a display **831** and the touch circuit **833** (e.g., the touch circuit **250** in FIG. **2**).

At least a portion of the flexible display **830** according to various embodiments may be realized to be withdrawable from the inner space of the housing **310** or **410** of the electronic device **801**. For example, in case that the electronic device **801** is converted from the closed state into the open state, at least a portion of the flexible display **830** may be exposed to the outer space of the housing **310** or **410** and thus a screen (e.g., the activation area) may extend. In case that the electronic device **801** is converted from the open state into the closed state, at least a portion of the flexible display **830** may be inserted into the inner space of the housing **310** or **410** and thus a screen may be reduced.

In an embodiment, the touch circuit **833** may include a transmitter (TX) (e.g., the transmitter **510** in FIG. **5**A) including multiple first electrode lines (e.g., multiple driving electrodes) and a receiver (RX) (e.g., the receiver **520** in FIG. **5**A) including multiple second electrode lines (e.g., multiple reception electrodes).

According to various embodiments of the disclosure, the touch controller **835** may be electrically connected to the flexible display **830**. The touch controller **835** may detect a physical quantity from the touch circuit **833** and calculate a user input, for example, data (e.g., coordinate data (X, Y) of a position at which a touch is performed) with respect to a touch based on a change of the physical quantity (e.g., a voltage, a light quantity, a resistance, a charge quantity, or a capacitance). The touch controller **835** may transfer the data with respect to a touch to the processor **840**. The processor **840** may acquire the data with respect to a touch as an event regarding the user input.

In various embodiments, the touch controller **835** may detect a state change of the flexible display **830**. For example, the touch controller **835** may detect conversion of the flexible display **830** from the open state (or including the intermediate state) into the closed state or conversion of the flexible display **830** from the closed state into the open state. The touch controller **835** may apply a driving signal through the multiple TX electrodes of the touch circuit **833**. The touch controller **835** may acquire a driving signal through the multiple RX electrodes of the touch circuit **833**. The processor **840** may identify a capacitance value based on the acquired driving signal. For example, at least a portion of the flexible display **830** may be inserted into the inner space of the housing **310** or **410** or withdrawn to the outside of the housing **310** or **410**. Depending on a degree by which the flexible display **830** is inserted into the inner space of the housing **310** or **410**, at least some areas of the flexible display **830** may overlap each other. For example, the at least some areas overlapping each other of the display area of the flexible display **830** may have interference occurring thereon due to display areas overlapping each other and thus may have a capacitance value different from that of the flexible display **830**. The touch controller **835** may identify information on the folded area of the flexible display **830** based on the capacitance value and transfer the information to the processor **840**.

In various embodiments, the touch controller **835** may include a touchscreen panel (TSP) IC.

In various embodiments, the touch controller **835** is described as a separate module from the processor **840** and the flexible display **830**, but is not limited thereto. For example, the touch controller **835** may be included in one module, chip, or package together with the processor **840** or the flexible display **830**. Alternatively, it may be obvious to a person in the art that the touch controller **835** may be omitted in case that the processor **840** or the flexible display **830** performs an operation of the touch controller **835**.

According to various embodiments of the disclosure, the processor **840** (e.g., the processor **120** in FIG. **1**) may include a micro controller unit (MCU) and may drive an operating system (OS) or an embedded software program to control multiple hardware components connected to the processor **840**. The processor **840** may control multiple hardware components according to instructions (e.g., the program **140** in FIG. **1**) stored in the memory **810**.

In an embodiment, the processor **840** may identify the folded area of the flexible display **830** received from the touch controller **835** and determine (e.g., configure or set) the folded area as a deactivation area. The processor **840** may determine (e.g., configure or set) an area other than the deactivation area of the flexible display **830** as an activation area.

In various embodiments, the electronic device **801** may include, a housing (e.g., the housing **310** in FIG. **3**A and FIG. **3**B or the housing **410** in FIG. **4**A and FIG. **4**B), a touch circuit **833** including multiple TX electrodes and multiple RX electrodes arranged to cross over the multiple TX electrode, a flexible display **830** including the touch circuit **833** which can be withdrawn from an inner space of the housing **310** or **410**, a touch controller **835**, and a processor **840** connected to the touch circuit **833**, the flexible display **830**, and the touch controller **835**, wherein the touch controller **835** applies a driving signal through the multiple TX electrodes of the touch circuit **833**, acquires the driving signal through the multiple RX electrodes, identifies a capacitance value based on the acquired driving signal, and identifies information about a folded area of the flexible display **830** based on the capacitance value, and the processor **840** may determine (e.g., configure or set) an activation area with respect to an unfolded area of the flexible display **830** based on the information about the folded area of the flexible display **830**.

In various embodiments, the processor **840** may determine (e.g., configure or set) an area of the display area of the flexible display **830**, which is inserted into the inner space of the housing **310** or **410** and formed to be a planar area, as a deactivation area.

In various embodiments, the processor **840** may be configured to determine an area of the display area of the flexible display **830** excluding the folded area and the area inserted into the inner space of the housing **310** or **410** and formed to be a planar area, as the unfolded area.

In various embodiments, after the activation area with respect to the unfolded area of the flexible display **830** is determined, the touch controller **835** may be configured to identify whether a state change of the flexible display **830** is detected and identify the capacitance value based on the driving signal acquired through the multiple RX electrodes as applied through the multiple TX electrodes based on the detection of the state change of the flexible display **830**.

In various embodiments, after the activation area with respect to the unfolded area of the flexible display **830** is determined, the touch controller **835** may be configured to identify the capacitance value based on the driving signal acquired through the multiple RX electrodes as applied through the multiple TX electrodes at a designated time interval.

In various embodiments, the processor **840** may be configured to detect movement of the folded area based on the capacitance value and adjust the activation area based on the detected movement of the folded area.

In various embodiments, the processor **840** may be configured to adjust a ratio of a screen to be displayed on the adjusted activation area and/or reconfigure the screen based on rearrangement, and output the reconfigured screen through the adjusted activation area.

In various embodiments, the electronic device **801** may further include a semicircular conductor (e.g., the semicircular conductor **1401** in FIG. **14**A or the semicircular conductor **1610** in FIG. **16**A) disposed in the inner space of the housing **310** or **410**.

In various embodiments, the touch controller **835** may be configured to apply the driving signal by using the semicircular conductor **1401** or **1610** based on the detection of a state change of the flexible display **830**.

In various embodiments, the state change of the flexible display **830** may include a change into a state in which the flexible display **830** is withdrawn from the inner space of the housing **310** or **410** of the electronic device **801** or inserted into the inner space of the housing **310** or **410**.

FIG. **9** is a flowchart **900** explaining a method for determining an activation area of a flexible display **830** according to various embodiments.

Referring to FIG. **9**, in operation **910**, a touch controller (e.g., the touch controller **835** in FIG. **8**) of the electronic device (e.g., the electronic device **801** in FIG. **8**) may apply a driving signal through multiple TX electrodes of a touch circuit (e.g., the touch circuit **833** in FIG. **8**) and acquire a driving signal through multiple RX electrodes.

In various embodiments, the flexible display **830** may include a touch circuit **833**. The touch circuit **833** may include a transmitter (TX) (e.g., the transmitter **510** in FIG. **5**A) including multiple first electrode lines (e.g., multiple driving electrodes) and a receiver (RX) (e.g., the receiver **520** in FIG. **5**A) including multiple second electrode lines (e.g., multiple reception electrodes).

In an embodiment, the touch controller **835** may apply a driving signal through the transmitter **510** (e.g., multiple first electrode lines) constituting the touch circuit **833**. A driving signal as applied through the transmitter **510** may be acquired through the receiver **520** (e.g., multiple second electrode lines) constituting the touch circuit **833**.

In an embodiment, in operation **920**, the touch controller **835** may identify a capacitance value based on the acquired driving signal.

For example, in case that the electronic device **801** is configured by a form factor of a rollable form shown in FIG. **3**A and FIG. **3**B, at least a portion of a flexible display (e.g., the flexible display **330** in FIG. **3**A and FIG. **3**B) may be rolled to be inserted into the inner space of the housing **310** or withdrawn to the outside of the housing **310**. Depending on a degree by which the flexible display **330** is rolled into the inner space of the housing **310**, at least some areas of the flexible display **330** may be rolled overlapping each other around a rotation axis (e.g., the rotation axis C in FIG. **3**A and FIG. **3**B).

In an embodiment, a capacitance value of the at least some areas of the display area of the flexible display **330**, which are rolled overlapping each other may be different from that of an area (e.g., a display area of the flexible display **330** withdrawn to the outside of the housing **310**) which is not overlappingly rolled. For example, a capacitance value of the at least some areas of the display area of the flexible display **330**, which are rolled overlapping each other, may have interference caused by the overlapping display area and accordingly may have a capacitance value different from that of an area (e.g., a display area of the flexible display **330** withdrawn to the outside of the housing **310**) which is not overlappingly rolled. A capacitance value of an area (e.g., a display area of the flexible display **330** withdrawn from the inner space of the housing **310**) of the display area of the flexible display **330**, which is not overlappingly rolled may not be changed.

In an embodiment, based on that a capacitance value of the at least some areas of the display area of the flexible display **330**, which are rolled overlapping each other is different from that of an area (e.g., a display area of the flexible display **330** withdrawn to the outside of the housing **310**) which is not overlappingly rolled, the electronic device **801** may distinguish the folded area and the planar area of the flexible display **330**.

For another example, in case that the electronic device **801** is configured by a form factor of the slidable form shown in FIG. **4**A and FIG. **4**B, the flexible display **430** (e.g., the flexible display **430** in FIG. **4**A and FIG. **4**B) may include a bendable section ②. The bendable section ② may include an extended portion of a screen **4301** when the electronic device **801** is converted from a closed state (e.g., the state of FIG. **4**A) into an open state (e.g., the state of FIG. **4**B). In case that the electronic device **801** is converted from the closed state into the open state, the bendable section ② may be slidably withdrawn to the outside of the electronic device **801** and as such, the screen **4301** may extend. In case that the electronic device **801** is converted from the open state into the closed state, at least a part of the bendable section ② may be slidably inserted into the inner space of the electronic device **801** and as such, the screen **4301** may be reduced. In this case, at least another portion of the bendable section ②, for example, a second curved portion **430***c* may be exposed to the outside.

In an embodiment, the electronic device **801** may include a pulley **710** disposed in the housing **410** to correspond to the bendable section ②. In case that the bendable section ② is inserted into the electronic device **801**, at least a portion **4302** of the bendable section ② may include a planar area **430***e* and a curved area **430***d* corresponding to the pulley **710**.

In an embodiment, in case that at least a portion of the flexible display **430** is inserted into the inner space of the electronic device **400**, a capacitance value of a partial area **430***c* or **430***d* of the bendable section ② of the flexible display **430** may be different from those of an area **430***a* or **430***b* of the flexible display **430** not inserted into the inner space of the electronic device **801** and an area **430***e* which is inserted into the inner space of the electronic device **400** but does not form a curved surface.

In an embodiment, based on that the capacitance value of the partial area **430***c* or **430***d* of the bendable section ② of the flexible display **430** is different from those of the area **430***a* or **430***b* of the flexible display **430** not inserted into the inner space of the electronic device **801** and the area **430***e* which is inserted into the inner space of the electronic device **400** but does not form a curved surface, the electronic device **801** may distinguish the folded area and the planar area of the flexible display **430**.

For example, due to interference as at least a portion of the flexible display **430** is inserted into the inner space of the electronic device **801**, a capacitance value of at least some areas **430***c* and **430***d* overlapping each other may be different from those of an area **430***a* or **430***b* of the flexible display **430** not inserted into the inner space of the electronic device **801** and an area **430***e* which is inserted into the inner space of the electronic device **801** but does not form a curved surface. For example, a charge amount acquired when the driving signal applied through the multiple first electrode lines (e.g., the multiple driving electrodes) of the transmitter **510** is received through the multiple second electrode lines constituting the at least some areas **430***c* and **430***d* overlapping each other may be different from a charge amount received through the multiple second electrode lines constituting the area **430***a* or **430***b* of the flexible display **430** not inserted into the inner space of the electronic device **801** and the area **430***e* which is inserted into the inner space of the electronic device **801** but does not form a curved surface.

In an embodiment, in operation **930**, the touch controller **835** may identify information on the folded area of the flexible display **830** based on the capacitance value. The touch controller **835** may transfer the information on the folded area of the flexible display **830** to the processor **840**.

In an embodiment, in operation **940**, the processor **840** may determine (e.g., configure or set) an activation area with respect to the unfolded area of the flexible display **830** based on the information about the folded area of the flexible display **830**. For example, the processor **840** may identify the folded area of the flexible display **830** received from the touch controller **835** and determine (e.g., configure or set) the folded area as a deactivation area. In an embodiment, the processor **840** may further determine (e.g., configure or set) an area which is inserted into the inner space of the electronic device **801** but does not form a curved surface as a deactivation area.

In an embodiment, the processor **840** may determine (e.g., configure or set) an area other than the deactivation area of the flexible display **830** as an activation area.

In operation **910** according to various embodiments, it is described that a capacitance value is identified based on the acquired driving signal, but is not limited thereto. For example, based on detection of a state change of the flexible display **830**, the touch controller **835** may acquire raw data with respect to a capacitance value of the entire display area of the flexible display **830**.

By way of example, the raw data may include a value indicating an electrostatic charge characteristic state formed in all or some channels of the touch circuit **833**. For another example, the raw data may include large amount of overall image information about touch sensitivity of the display area of the flexible display **830**. For still another example, the raw data may include raw data with respect to a peripheral area including at least a portion of flexible display **830** of the electronic device **801**, for example, a bending area and/or a rolled area. The raw data may be acquired in a form of a table, a matrix, or a string.

In various embodiments, the touch controller **835** may transfer the data to be acquired to the processor **840**.

In various embodiments, the processor **840** may analyze the raw data received from the touch controller **835** and identify a capacitance value based on the analyzed raw data. In another embodiment, the processor **840** may image-process the raw data received from the touch controller **835** and identify a capacitance value based on the processed raw data. Based on the capacitance value, the processor **840** may identify an operation state (e.g., a state of being withdrawn from the inner space of the housing **310** or **410** (e.g., a state of withdrawing to the outer space of the housing **310** or **410**) or a state of being inserted into the inner space of the housing **310** or **410**) of the flexible display **830** and/or the folded area of the flexible display **830** in real time. In another embodiment, the processor **840** may analyze the raw data received from the touch controller **835** through machine learning, and, based on a raw data change, identify an operation state (e.g., a state of being withdrawn from the inner space of the housing **310** or **410** (e.g., a state of withdrawing to the outer space of the housing **310** or **410**) or a state of being inserted into the inner space of the housing **310** or **410**) of the flexible display **830** and/or the folded area of the flexible display **830** in real time.

In various embodiments, it is described that the processor **840** performs the operations, but is not limited thereto. For example, the touch controller **835** may generate raw data, directly analyze the raw data, and identify an operation state of the flexible display **830** and/or the folded area of the flexible display **830** in real time. In case of detecting an event with respect to the folded area of the flexible display **830** and/or an operation state of the flexible display **830**, the touch controller **835** may transfer to the processor **840** a signal indicating that an event (e.g., a bending event) is detected.

In another words, the touch controller **835** may transfer raw data to the processor **840** in case of detecting a change of a predetermined degree. The processor **840** may identify whether the change of a predetermined degree includes an operation state of the flexible display **830**, for example, a closed state, an open state, an intermediate state, and/or state conversion (e.g., initiation of an opening operation or initiation of a closing operation).

In various embodiments, raw data analysis and event detection with respect to the folded area may be performed by the touch controller **835** and thus by transferring the same to the processor **840** in case of detecting a bending event, an operation of the processor **840** may be minimized.

In various embodiments, it is described that the raw data is received by the processor **840** or the touch controller **835**, but is not limited thereto. By way of example, the raw data may be configured to be acquired by a service layer, a hardware abstraction layer (HAL), or a driver layer included in software module layers, or firmware of a touch controller (not shown).

In various embodiments, although not shown, in case that the flexible display **830** maintains rolled to a specific size and a state change of the flexible display **830** is detected, the touch controller **835** may acquire raw data. Without limitation thereto, in case that the state change of the flexible display **830** is not detected, the touch controller **835** may acquire raw data with respect to the flexible display **830** at a predetermined period. Alternatively, in case that the electronic device **801** is a low-end electronic device **801**, raw data may be acquired only when necessary, in order to reduce load on the electronic device **801**.

In various embodiments, although not shown, an operation of performing image-processing based on raw data may include an operation of dividing the display area of the flexible display **830** into an activation area and a deactivation area, visualizing the same, and performing mapping the same to resolution reference coordinate values of the flexible display **830**, based on the raw data with respect to the folded area of the flexible display **830**, which is transferred at a specific time point. In various embodiments, based on information with respect to the previously determined activation area and deactivation area and/or a pattern, in case that a capacitance change more than or equal to a predetermined value is detected, update with respect to the activation area of the flexible display **830** may be performed to minimize processing load.

In various embodiments, although not shown, in a state in which the flexible display **830** is withdrawn from the inner space of the housing **310** or **410**, in case that an input is not detected for a designated time, the electronic device **801** may enter a sleep mode (e.g., a low-power mode). The electronic device **801** may generate a wake-up signal and the electronic device **801** may be controlled to operate in a wake-up mode through a wake-up signal.

In another embodiment, in case of a state in which the electronic device **801** is woken up in an idle state to display visual information on the flexible display **830**, the electronic device **801** may generate a sliding operation signal and control to notify the sliding operation of the electronic device **801** in real time through the sliding operation signal.

The wake-up signal and the sliding operation signal described above according to various embodiments may be used as a signal to wake the electronic device **801** in a state in which the electronic device **801** operates in a sleep mode or low-power mode to reduce current consumption after a predetermined time has elapsed.

In various embodiments, operation **910** to operation **940** described above may be performed in case that series of operations (e.g., a state change of the flexible display **330**) is detected. Without limitation thereto, operation **910** to operation **940** described above may be performed at designated time intervals.

In various embodiments, a display method of an electronic device **801** including a flexible display **830** may include an operation of applying a driving signal by using multiple TX electrodes of a touch circuit **833** included in the flexible display **830**, an operation of acquiring the driving signal through the multiple RX electrodes of the touch circuit **833**, an operation of identifying a capacitance value based on the acquired driving signal, an operation of identifying information about a folded area of the flexible display **830** based on the capacitance value, and an operation of determining (e.g., configure or set) an activation area with respect to an unfolded area of the flexible display **830** based on the information about the folded area of the flexible display **830**.

In various embodiments, the operation of configuring the activation area with respect to the unfolded area of the flexible display **830** may include an operation of configuring an area of the display area of the flexible display **830**, which is inserted into the inner space of the housing **310** or **410** and formed to be a planar area, as a deactivation area.

In various embodiments, the operation of determining (e.g., configure or set) the activation area with respect to the unfolded area of the flexible display **830** may include an operation of determining an area excluding the folded area and an area of the display area of the flexible display **830**, which is inserted into the inner space of the housing **310** or **410** and formed to be a planar area, as the unfolded area.

In various embodiments, the display method of the electronic device **801** including the flexible display **830** may further include an operation of identifying, after the activation area with respect to the unfolded area of the flexible display **830** is determined, whether a state change of the flexible display **830** is detected and an operation of identifying the capacitance value based on the driving signal acquired through the multiple RX electrodes as applied through the multiple TX electrodes based on the detection of the state change of the flexible display **830**.

In various embodiments, the display method of the electronic device **801** including the flexible display **830** may further include an operation of identifying, after the activation area with respect to the unfolded area of the flexible display **830** is determined, the capacitance value at designated time intervals based on the driving signal acquired through the multiple RX electrodes as applied through the multiple TX electrodes.

In various embodiments, the display method of the electronic device **801** including the flexible display **830** may further include an operation of detecting movement of the folded area based on the capacitance value and an operation of adjusting the activation area based on the detected movement of the folded area.

In various embodiments, the display method of the electronic device **801** including the flexible display **830** may further include an operation of adjusting a ratio of a screen to be displayed on the adjusted activation area and/or reconfiguring the screen based on rearrangement, and an operation of outputting the reconfigured screen through the adjusted activation area.

In various embodiments, the electronic device **801** may further include a semicircular conductor (e.g., the semicircular conductor **1401** in FIG. **14**A or the semicircular conductor **1610** in FIG. **16**A) disposed in the inner space of the housing **310** or **410** of the electronic device **801**.

In various embodiments, the display method of the electronic device **801** including the flexible display **830** may further include an operation of applying the driving signal by using the semicircular conductor **1401** or **1610** based on the detection of a state change of the flexible display **830**.

In various embodiments, the state change of the flexible display **830** may include that the flexible display **830** is changed to be in a state of being withdrawn from the inner space of the housing **310** or **410** of the electronic device **801** or in a state of being inserted into the inner space of the housing **310** or **410**.

FIG. **10**A is a view **1000** explaining a method for applying a driving signal from a transmitter including multiple first electrode lines constituting a touch circuit **833** of a flexible display **330** according to various embodiments. FIG. **10**B is a view **1050** explaining a method for identifying a capacitance value based on acquisition of a driving signal through a receiver including multiple second electrode lines constituting a touch circuit **833** of a flexible display **330** according to various embodiments.

FIG. **10**A according to various embodiments is a front view of an electronic device (e.g., the electronic device **801** in FIG. **8**) viewed from one side in a state in which at least a portion of a flexible display (e.g., the flexible display **330** in FIG. **3**A and FIG. **3**B) is inserted into an inner space of a housing (e.g., the housing **310** in FIG. **3**A and FIG. **3**B) and at least another portion of the flexible display **330** is withdrawn to an outer space of the housing **310**. For example, FIG. **10**A according to various embodiments may be a view illustrating the electronic device **801** viewed from the −y-axis direction to the +y-axis direction with reference to FIG. **3**A and FIG. **3**B.

FIG. **10**A according to various embodiments illustrates a case that a driving signal is applied from a transmitter (e.g., the transmitter **510** in FIG. **5**A) (e.g., multiple first electrode lines) in an inward direction (e.g., direction ①) of the flexible display **330**.

Referring to FIG. **10**A, as the flexible display **330** is rolled in a circle around a rotation axis (e.g., the rotation axis C in FIG. **3**A and FIG. **3**B) (e.g., as inserted into the inner space of the housing (e.g., the housing **310** in FIG. **3**A and FIG. **3**B), an area **1010** or **1020** including a first section (e.g., a) to a third section (e.g., c) of the display area of the flexible display **330** may be disposed in the inner space of the housing **310**. For example, a partial area **1010** (e.g., an area including the first section (e.g., a) to a second section (e.g., b)) of the first section (e.g., a) to the third section (e.g., c) of the display area may be inserted into the inner space of the housing **310** and formed to be a planar area. Another area **1020** (e.g., an area including the second section (e.g., b) to the third section (e.g., c) of the display area may be rolled in a circle around the rotation axis C. An area **1030** of the display area excluding the area **1020** including the first section (e.g., a) to the third section (e.g., c) may be exposed to the outside of the housing **310** and formed to be a planar area.

In an embodiment, a capacitance value with respect to the area **1020** including the second section (e.g., b) to the third section (e.g., c) of the display area of the flexible display **330** rolled into the inner space of the housing **310** of the flexible display **330** in FIG. **10**A may be different from that of the display areas **1010** and **1030** of the flexible display **430** corresponding to the planar area.

In FIG. **10**B according to various embodiments, the x-axis indicates an area **1060** of the unfolded flexible display **330** and the y-axis shows a capacitance value **1065** of the flexible display **330**.

For example, referring to **10**B, in case that a driving signal is applied from the transmitter (e.g., the transmitter **510** in FIG. **5**A) (e.g., the multiple first electrode lines) in an inward direction (e.g., direction ①) of the flexible display **330**, an area **1020** rolled in a circle may cause a potentiating effect in a portion corresponding to the inside (e.g., direction ①) of the area **1020** rolled in a circle due to interference from the surroundings. Accordingly, the rolled area **1020** of the flexible display **330** may have a second capacitance value **1075** different from a first capacitance value **1070** of the display area **1010** or **1030** corresponding to the planar area.

In an embodiment, based on that the rolled area **1020** of the flexible display **330** has the second capacitance value **1075** different from the first capacitance value **1070** of the display area **1010** or **1030** corresponding to the planar area, the electronic device **801** may recognize that each area **1010**, **1020**, or **1030** of the flexible display **330** is in a different state (e.g., a rolled state or an unfolded state). That is, based on that each area **1010**, **1020**, or **1030** of the flexible display **330** has a different capacitance value, the electronic device **801** may distinguish a folded area and a planar area.

For example, an electrostatic charge applied by the transmitter **510** is introduced to the receiver **520** in the rolled area **1020** of the flexible display **330**, and due to an electrostatic charge applied by the transmitter **510** of a physically adjacent line (e.g., due to interference of a transmission signal), a capacitance received by the receiver **520** of the rolled area **1020** may be larger than a capacitance received by the receiver **520** of the display area **1010** or **1030**. However, the disclosure is not limited thereto.

In an embodiment, based on a capacitance value of the area **1020** corresponding to the rolled area (e.g., the area including the second section (e.g., b) to the third section (e.g., c)) of the flexible display **330**, the electronic device **801** may determine the area **1020** including the second section (e.g., b) to the third section (e.g., c) of the flexible display **830** as a bending area, for example, a folded area. Based on the area **1020** including the second section (e.g., b) to the third section (e.g., c) of the flexible display **330**, which is determined as the folded area, the electronic device **801** may determine a deactivation area of the flexible display **330**. The electronic device **801** may determine an area **1030** excluding the deactivation area with respect to the folded area of the flexible display **330** as an activation area.

In an embodiment, the electronic device **801** may further determine an area **1010** (e.g., an area including the first section (e.g., a) to the second section (e.g., b)) formed by a planar area of the display area of the flexible display **330**, which is inserted into the housing **310** as a deactivation area. For example, based on a configuration value (e.g., a specific distance value from an end of the folded area) stored in a memory (e.g., the memory **130** in FIG. **1**), the electronic device **801** may determine an area (e.g., an area including the first section (e.g., a) to the second section (e.g., b)) formed by a planar area inserted into the housing **310**.

In various embodiments, the electronic device **801** may generate raw data for the display area of the flexible display **330** based on a capacitance value. The electronic device **801** may perform image processing based on the raw data for the display area. Based on an image (e.g., the image **555** in FIG. **5**B) generated through image processing, the electronic device **801** may detect a rectangular image with respect to the display area of the flexible display **330**. For example, the raw data of the area **1020** (e.g., **560** in FIG. **5**B) including the second section (e.g., b) to the third section (e.g., c) may be large compared to the raw data with respect to the planar area **1030** (e.g., **565** in FIG. **5**B). Based on that the raw data of the area **1020** including the second section (e.g., b) to the third section (e.g., c) is larger, a rectangular image with respect to an area having large raw data may be detected. The electronic device **801** may determine the area of the flexible display **330** corresponding to the rectangular image detected from an image generated through image processing as a bending area.

In FIG. **10**A and FIG. **10**B according to various embodiments, the application a driving signal by the transmitter **510** of the flexible display **330** in an inward direction (e.g., direction ①) of the flexible display **330** is merely an embodiment and is not limited thereto. For example, in various embodiments, the transmitter **510** of the flexible display **330** may apply a driving signal in an outward direction (e.g., direction ②) different from the inward direction (e.g., direction ①) of the flexible display **330**. In this regard, description will be made with reference to FIG. **11**A and FIG. **11**B.

FIG. **11**A is a view **1100** explaining a method for applying a driving signal from a transmitter including multiple first electrode lines constituting a touch circuit **833** of a flexible display **330** according to various embodiments. FIG. **11**B is a view **1150** explaining a method for identifying a capacitance value based on acquisition of a driving signal through a receiver including multiple second electrode lines constituting a touch panel **833** of a flexible display **330** according to various embodiments.

FIG. **11**A according to various embodiments is a front view of an electronic device (e.g., the electronic device **801** in FIG. **8**) viewed from one side in a state in which at least a portion of a flexible display (e.g., the flexible display **330** in FIG. **3**A and FIG. **3**B) is inserted into an inner space of a housing (e.g., the housing **310** in FIG. **3**A and FIG. **3**B) and at least another portion of the flexible display **330** is withdrawn from an inner space of the housing **310**. For example, FIG. **11**A according to various embodiments may be a view illustrating the electronic device **801** viewed from the −y-axis direction to the +y-axis direction with reference to FIG. **3**A and FIG. **3**B.

FIG. **11**A according to various embodiments illustrates a case that a driving signal is applied from a transmitter (e.g., the transmitter **510** in FIG. **5**A) (e.g., multiple first electrode lines) in an outward direction (e.g., direction ②) of the flexible display **330**.

Referring to FIG. **11**A, as the flexible display **330** is rolled in a circle around a rotation axis (e.g., the rotation axis C in FIG. **3**A and FIG. **3**B), an area **1120** including a first section (e.g., a) to a third section (e.g., c) of the display area of the flexible display **330** may be disposed in the inner space of the housing **310**. For example, a partial area **1110** (e.g., an area including the first section (e.g., a) to a second section (e.g., b)) of the first section (e.g., a) to the third section (e.g., c) of the display area may be inserted into the inner space of the housing **310** and formed to be a planar area. Another area **1120** (e.g., an area including the second section (e.g., b) to the third section (e.g., c) of the display area may be rolled in a circle around the rotation axis C. An area **1130** of the display area excluding the area **1110** or **1120** including the first section (e.g., a) to the third section (e.g., c) may be exposed to the outside of the housing **310** and formed to be a planar area.

In an embodiment, a capacitance value with respect to the area **1120** including the second section (e.g., b) to the third section (e.g., c) of the display area of the flexible display **330** rolled into the inner space of the housing **310** of the flexible display **330** in FIG. **11**A may be different from that of the display areas **1110** and **1130** of the flexible display **430** corresponding to the planar area.

In FIG. **11**B according to various embodiments, the x-axis indicates an area **1160** of the unfolded flexible display **330** and the y-axis shows a capacitance value **1170** of the flexible display **330**.

For example, referring to **11**B, in case that a driving signal is applied from the transmitter (e.g., the transmitter **510** in

FIG. **5**A) (e.g., the multiple first electrode lines) in an outward direction (e.g., direction ②) of the flexible display **330**, an area **1120** rolled in a circle may have a capacitance value different from that of the display area **1110** or **1130** corresponding to the planar area due to interference from the surroundings. By way example, in case of scanning a capacitance at a predetermined time interval (e.g., once every 8 ms), the electronic device **801** may generate an image with a curve by image processing a value indicating a charge amount. The electronic device **801** may determine, as a bending area, an area having a shape significantly lower or higher than surroundings in the generated image. Since the scanning is performed at a predetermined time interval, the raw data may be regarded as an image for video playback being changed in real time and accordingly, a folded area of the flexible display **830** may be identified in real time.

In an embodiment, a capacitance value of the area **1120** corresponding to the rolled area of the flexible display **330** may have a second capacitance value **1180** different from a first capacitance value **1185** of the display area **1110** or **1130** corresponding to the planar area.

For example, the second capacitance value **1180** of the area **1120** corresponding to the rolled area of the flexible display **330** may be larger than the first capacitance value **1185** of the display area **1110** or **1130** corresponding to the planar area. However, the disclosure is not limited thereto.

In various embodiments, as described above, a charge amount of the bending area **1120** and a charge amount of the planar area **1110** or **1130** may be different and by performing image-processing thereon, the folded area of the flexible display **830** may be identified in real time.

In an embodiment, based on that the capacitance value of the area **1120** including the second section (e.g., b) to the third section (e.g., c) of the flexible display **330** and the capacitance value of the display area **1110** or **1130** of the flexible display **430** are different, the electronic device **801** may recognize that each area **1110**, **1120**, or **1130** of the flexible display **330** is in a different state (e.g., a rolled state or an unfolded state). That is, based on that each area **1110**, **1120**, or **1130** of the flexible display **330** has a different capacitance value, the electronic device **801** may distinguish a folded area and a planar area. For example, based on the capacitance value of the area **1120** including the second section (e.g., b) to the third section (e.g., c) of the flexible display **330**, the electronic device **801** may determine the area **1120** including the second section (e.g., b) to the third section (e.g., c) of the flexible display **330** as a bending area, for example, a folded area. Based on the area **1120** including the second section (e.g., b) to the third section (e.g., c) of the flexible display **330**, which is determined as the folded area, the electronic device **801** may determine a deactivation area of the flexible display **330**. The electronic device **801** may determine an area **1030** excluding the deactivation area with respect to the folded area of the flexible display **330** as an activation area.

In an embodiment, the electronic device **801** may further determine an area **1110** (e.g., an area including the first section (e.g., a) to the second section (e.g., b)) formed by a planar area of the display area of the flexible display **330**, which is inserted into the inner space the housing **310** as a deactivation area.

The activation area according to various embodiments may be an area on which visual information (e.g., a text, an image, and/or an icon) is displayed. However, without limitation thereto, the activation area may correspond to an area for processing only touch coordinates occurring in the activation area as valid coordinates. Accordingly, touch coordinates detected from the deactivation area of the flexible display **330** inserted into the inner space of the housing **310** may be configured not to be processed. In another embodiment, in case that the flexible display **330** is rolled to the outside of the housing **310**, for example, the outside of a back cover of the electronic device **801**, an area rolled to the outside of the back cover may be configured as a deactivation area and touch coordinates detected from the deactivation area may be configured not to be processed. Accordingly, a malfunction which may occur in the deactivation area may be prevented.

FIG. **12**A is a view **1200** explaining a method for applying a driving signal from a transmitter including multiple first electrode lines constituting a touch circuit **833** of a flexible display **430** according to various embodiments. FIG. **12**B is a view **1250** explaining a method for detecting a capacitance change based on acquisition of a driving signal through a receiver including multiple second electrode lines constituting a touch circuit **833** of a flexible display **430** according to various embodiments.

FIG. **12**A according to various embodiments is a front view of the electronic device **400** viewed from one side in a state in which at least a portion of a flexible display (e.g., the flexible display **430** in FIG. **4**A and FIG. **4**B) is inserted into an inner space of a housing (e.g., the housing **410** in FIG. **4**A and FIG. **4**B) and at least another portion of the flexible display **430** is withdrawn to an outer space of the housing **410**. For example, FIG. **12**A according to various embodiments may be a view illustrating the electronic device (e.g., the electronic device **801** in FIG. **8**) viewed from the −y-axis direction to the +y-axis direction with reference to FIG. **4**A and FIG. **4**B.

Referring to FIG. **12**A, as the flexible display **430** is inserted into the inner space of the housing **410** (or the electronic device **801**), a curved area may be formed based on an area **1220** including the first section (e.g., a) to the second section (e.g., b) of the display area of the flexible display **430**, and an area **1230** or **1240** excluding an area including the first section (e.g., a) to the second section (e.g., b) may be configured as a planar area.

In an embodiment, a capacitance with respect to the area **1220** inserted in the inner space of the housing **410** of the flexible display **430** to correspond to a curved surface of a pulley (e.g., the pulley **710** in FIG. **7**) in FIG. **13**A may be different from a capacitance with respect to the display area **1230** or **1240** of the flexible display **430** corresponding to the planar area.

In FIG. **12**B according to various embodiments, the x-axis indicates an area **1260** of the unfolded flexible display **430** and the y-axis shows a capacitance value **1270** of the unfolded flexible display **430**.

For example, referring to **12**B, in case that a driving signal **1210** is applied from a transmitter (e.g., the transmitter **510** in FIG. **5**A) (e.g., the multiple first electrode lines) in an inward direction (e.g., direction ①) of the flexible display **430**, the area **1220** corresponding to a curved surface of a pulley (e.g., the pulley **710** in FIG. **7**) may cause a potentiating effect in a portion corresponding to the inside (e.g., direction ①) of the area corresponding to the curved surface due to interference from the surroundings. Accordingly, the capacitance of the area **1220** corresponding to the curved surface of the flexible display **430** may be changed. For example, the area **1220** corresponding to the curved surface of the flexible display **430** may have a second capacitance value **1285** different from a first capacitance value **1280** of the display area **1230** or **1240** corresponding to the planar area.

For example, an electrostatic charge applied by the transmitter **510** is introduced to the receiver **520** in the area **1220** corresponding to the curved surface of the flexible display **430**, and due to an electrostatic charge applied by the transmitter **510** of a physically adjacent line (e.g., due to interference of a transmission signal), a capacitance received by the receiver **520** of the area **1220** corresponding to the curved surface may be larger than a capacitance received by the receiver **520** of the display area **1230** or **1240**. However, the disclosure is not limited thereto.

In an embodiment, based on that the capacitance value of the area **1220** corresponding to the curved surface of the flexible display **430** and the capacitance value of the display area **1230** or **1240** corresponding to the planar area of the flexible display **430** are different, the electronic device **801** may recognize that each area **1220**, **1230**, or **1240** of the flexible display **330** is in a different state (e.g., a rolled state or an unfolded state). That is, based on that each area **1220**, **1230**, or **1240** of the flexible display **330** has a different capacitance value, the electronic device **801** may distinguish a folded area and a planar area.

For example, based on the capacitance value of the flexible display **430**, the electronic device **810** may determine an area including the first section (e.g., a) to the second section (e.g., b) of the flexible display **430** having the relatively large second capacitance value **1285** as a bending area, for example, a folded area. Based on the area **1220** including the first section (e.g., a) to the second section (e.g., b) of the flexible display **430**, which is determined as the folded area, the electronic device **801** may determine a deactivation area of the flexible display **430**. The electronic device **801** may determine an area **1230** excluding the deactivation area with respect to the folded area of the flexible display **430** as an activation area.

In various embodiments, the electronic device **801** may determine, as an activation area, an area exposed to the outside of the electronic device **801**, for example, a second curved portion (e.g., the second curved portion **430***c* in FIG. **4**A) of the area determined as the bending area of the flexible display **430**.

In various embodiments, the electronic device **801** may further determine an area **1240** formed by the planar area of the display area of the flexible display **430**, which is inserted into the housing **410**, as a deactivation area. For example, based on a configuration value (e.g., a specific distance value from an end of the folded area) stored in a memory (e.g., the memory **130** in FIG. **1**), the electronic device **801** may determine an area **1240** formed by a planar area inserted into the housing **410**.

In FIG. **12**A and FIG. **12**B, the application a driving signal by the transmitter **510** of the flexible display **430** in an inward direction (e.g., direction ①) of the flexible display **430** is merely an embodiment and is not limited thereto. For example, in various embodiments, the transmitter **510** of the flexible display **430** may apply a driving signal in an outward direction (e.g., direction ②) different from the inward direction (e.g., direction ①) of the flexible display **430**. In this regard, description will be made with reference to FIG. **13**A and FIG. **13**B.

FIG. **13**A is a view **1300** explaining a method for applying a driving signal from a transmitter including multiple first electrode lines constituting a touch circuit **833** of a flexible display **430** according to various embodiments. FIG. **13**B is a view **1350** explaining a method for detecting a capacitance value based on acquisition of a driving signal through a receiver including multiple second electrode lines constituting a touch circuit **833** of a flexible display **430** according to various embodiments.

FIG. **13**A according to various embodiments is a front view of an electronic device (e.g., the electronic device **400** in FIG. **4**A and FIG. **4**B) viewed from one side in a state in which at least a portion of a flexible display (e.g., the flexible display **430** in FIG. **4**A and FIG. **4**B) is inserted into an inner space of a housing (e.g., the housing **410** in FIG. **4**A and FIG. **4**B) and at least another portion of the flexible display **430** is withdrawn from the inner space of the housing **410**. For example, according to various embodiments, FIG. **13**A may be a view illustrating the electronic device **400** viewed from the −y-axis direction to the +y-axis direction with reference to FIG. **4**A and FIG. **4**B.

FIG. **13**A according to various embodiments illustrates a case that a driving signal is applied from a transmitter (e.g., the transmitter **510** in FIG. **5**A) (e.g., multiple first electrode lines) in an outward direction (e.g., direction ②) of the flexible display **430**.

Referring to FIG. **13**A, as the flexible display **430** is inserted into the inner space of the housing **410** (or the electronic device **400**), a curved area may be formed based on an area **1320** including the first section (e.g., a) to the second section (e.g., b) of the display area of the flexible display **430**, and an area **1330** or **1340** excluding an area **1320** including the first section (e.g., a) to the second section (e.g., b) may be configured as a planar area.

In an embodiment, a capacitance with respect to the area **1320** inserted in the inner space of the housing **410** of the flexible display **430** to correspond to a curved surface of a pulley (e.g., the pulley **710** in FIG. **7**) in FIG. **13**A may be different from a capacitance with respect to the display area **1330** or **1340** of the flexible display **430** corresponding to the planar area.

In FIG. **13**B according to an embodiment, the x-axis indicates an area **1360** of the unfolded flexible display **430** and the y-axis shows a capacitance value **1370** of the unfolded flexible display **430**.

For example, referring to **13**B, in case that a driving signal **1310** is applied from a transmitter (e.g., the transmitter **510** in FIG. **5**A) (e.g., the multiple first electrode lines) in an outward direction (e.g., direction ②) of the flexible display **430**, the area **1320** corresponding to a curved surface of a pulley (e.g., the pulley **710** in FIG. **7**) may cause a potentiating effect in a portion corresponding to the outside (e.g., direction ②) of the area corresponding to the curved surface due to interference from the surroundings. Accordingly, the capacitance of the area **1320** corresponding to the curved surface of the flexible display **430** may be changed. For example, the area **1320** corresponding to the curved surface of the flexible display **430** may have a second capacitance value **1380** different from a first capacitance value **1385** of the display area **1330** or **1340** corresponding to the planar area.

For example, an electrostatic charge applied by the transmitter **510** is introduced to the receiver **520** in the area **1320** corresponding to the curved surface of the flexible display **430**, and due to an electrostatic charge applied by the transmitter **510** of a physically adjacent line (e.g., due to interference of a transmission signal), a capacitance received by the receiver **520** of the area **1320** corresponding to the curved surface may be smaller than a capacitance received by the receiver **520** of the display area **1330** or **1340**. However, the disclosure is not limited thereto.

In an embodiment, based on a capacitance value of each area **1320**, **1330**, or **1340** of the flexible display **430**, the electronic device 810 may determine an area 1320 including the first section (e.g., a) to the second section (e.g., b) of the flexible display 430 having the relatively small second capacitance value 1380 as a bending area, for example, a folded area. Based on the area 1320 including the first section (e.g., a) to the second section (e.g., b) of the flexible display 430, which is determined as the folded area, the electronic device 801 may determine a deactivation area of the flexible display 430. The electronic device 801 may determine an area 1330 excluding the deactivation area with respect to the folded area of the flexible display 430 as an activation area.

In various embodiments, the electronic device 801 may determine, as an activation area, an area exposed to the outside of the electronic device 801, for example, a second curved portion (e.g., the second curved portion 430*c* in FIG. 4A) of the area determined as the bending area of the flexible display 430.

In various embodiments, the electronic device 801 may further determine an area 1340 formed by the planar area of the display area of the flexible display 430, which is inserted into the housing 410, as a deactivation area. For example, based on a configuration value (e.g., a specific distance value from an end of the folded area) stored in a memory (e.g., the memory 130 in FIG. 1), the electronic device 801 may determine an area 1340 formed by a planar area inserted into the housing 410.

FIG. 14A is a view 1400 illustrating a semicircular conductor 1401 disposed in an inner space of a housing 310 of an electronic device 801 according to various embodiments. FIG. 14B is a view 1430 explaining a method for applying a driving signal from a transmitter including multiple first electrode lines constituting a touch circuit 833 of a flexible display 330 according to various embodiments. FIG. 14C is a view 1450 explaining a method for identifying a capacitance value based on acquisition of a driving signal through a receiver including multiple second electrode lines constituting a touch circuit 833 of a flexible display 330 according to various embodiments.

Referring to FIG. 14A, at least a portion of the flexible display 330 (e.g., the flexible display 330 in FIG. 3A and FIG. 3B) of the electronic device (e.g., the electronic device 801 in FIG. 8) may be inserted into the inner space of the housing 310 (e.g., the housing 310 in FIG. 3A and FIG. 3B) while being rolled in a circle around a rotation axis (e.g., the rotation axis C in FIG. 3A and FIG. 3B), and at least another portion of the flexible display 330 may be in a state of being withdrawn to the outer space of the housing 310.

In an embodiment, the electronic device 801 may further include a semicircular conductor 1401 disposed in the inner space of the housing 310.

In an embodiment of FIG. 14A according to various embodiments, compared to the embodiment of FIG. 11A, as the semicircular conductor 1401 is disposed in the inner space of the housing 310, a capacitance value with respect to the display area of the flexible display 330 corresponding to a curved bending area of the flexible display 330 in FIG. 14A may be smaller than a capacitance value with respect to the display area 1120 of the flexible display 330 corresponding to a curved bending area of the flexible display 330 in FIG. 11A.

For example, referring to FIG. 14B, as the flexible display 330 is rolled, an area 1410 or 1415 including the first section (e.g., a) to the third section (e.g., c) of the display area of the flexible display 330 may be disposed in the inner space of the housing 310. For example, a partial area 1410 (e.g., an area including the first section (e.g., a) to a second section (e.g., b)) of the first section (e.g., a) to the third section (e.g., c) of the display area may be inserted into the inner space of the housing 310 and formed to be a planar area. Another area 1415 (e.g., an area including the second section (e.g., b) to the third section (e.g., c)) of the display area may be rolled in a circle around the rotation axis C. An area 1420 of the display area excluding the area 1410 or 1415 including the first section (e.g., a) to the third section (e.g., c) may be exposed to the outside of the housing 310 and formed to be a planar area.

In an embodiment, as the electronic device 301 further includes the semicircular conductor 1401 in the inner space of the housing 310, a driving signal 1405 may be applied through the transmitter 410 of the flexible display 330 and a driving signal 1425 may be applied through the semicircular conductor 1401.

In an embodiment, the driving signals 1405 and 1425 applied through the transmitter 410 of the flexible display 330 and the semicircular conductor 1401 may be acquired through a receiver (e.g., the receiver 420 in FIG. 4A) (e.g., the multiple second electrode lines) of the flexible display 330.

In FIG. 14C according to various embodiments, the x-axis indicates an area 1460 of the unfolded flexible display 330 and the y-axis shows a capacitance value 1470 of the flexible display 330.

For example, referring to FIG. 14C, in a structure in which the semicircular conductor 1401 according to the embodiments of FIG. 14A and FIG. 14B, an area 1417 including a fourth section (e.g., d) to a fifth section (e.g., e) may have a third capacitance value 1480 different from a first capacitance value 1490 of the display area 1410 or 1420 of the display area corresponding to the planar area and a second capacitance value 1485 of an area 1415 including the second section (e.g., b) to the third section (e.g., c) excluding an the area 1417 including the fourth section (e.g., d) to the fifth section (e.g., e).

By further including the semicircular conductor 1401 in FIG. 14A and FIG. 14B according to various embodiments, based on that a capacitance value (e.g., the third capacitance value 1480) of the area 1415 including the second section (e.g., b) to the third section (e.g., c) is different from capacitance values (e.g., the first capacitance value 1490 and the second capacitance value 1485) of other areas (e.g., based on that the capacitance value is relatively small), the bending area of the flexible display 330 may be accurately detected.

In an embodiment, based on a capacitance value (e.g., the third capacitance value 1480) of the area 1417 including the fourth section (e.g., d) to the fifth section (e.g., e) of the flexible display 330, the electronic device 801 may determine the area 1417 including the fourth section (e.g., d) to the fifth section (e.g., e) of the flexible display 330 as a bending area, for example, a folded area. In an embodiment, the electronic device 801 may determine an area (e.g., an area including the second section (e.g., b) to the fourth section (e.g., d) and an area including the fifth section (e.g., e) to the third section (e.g., c)) having the second capacitance value 1485, in addition to the area 1417 including the fourth section (e.g., d) to the fifth section (e.g., e), as a bending area. Based on the area 1415 including the second section (e.g., b) to the third section (e.g., c) of the flexible display 330, which is determined as the folded area, a deactivation area may be determined. The electronic device 801 may determine an area 1420 excluding the deactivation area with respect to the folded area of the flexible display 330 as an activation area.

In an embodiment, the electronic device **801** may further determine an area **1410** (e.g., an area including the first section (e.g., a) to the second section (e.g., b)) formed by a planar area of the display area of the flexible display **330**, which is inserted into the housing **310** as a deactivation area.

FIG. **15** is a view **1500** explaining a method for determining an activation area of a flexible display **330** according to various embodiments.

Referring to FIG. **15**, in a structure in which the semicircular conductor **1401** according to the embodiment of FIG. **14**A and FIG. **14**B described above, of the display area of the flexible display **330**, an area **1550** (e.g., the area having a capacitance value (e.g., the third capacitance value **1480** in FIG. **14**B) different from other areas **1520**, **1530**, and **1540**) including the fourth section (e.g., d) to the fifth section (e.g., e) of the flexible display **330** may be determined as a folded area. However, without limitation thereto, the electronic device **801** may determine an area (e.g., an area **1540** including the second section (e.g., b) to the fourth section (e.g., d) and an area **1540** including the fifth section (e.g., e) to the third section (e.g., c)) having a second capacitance value (e.g., the second capacitance value **1485** in FIG. **14**B) different from a first capacitance value (e.g., the first capacitance value **1490** in FIG. **14**B), in addition to the area **1417** including the fourth section (e.g., d) to the fifth section (e.g., e), as a bending area. The electronic device **801** may further determine an area **1530** (e.g., an area including the first section (e.g.) to the second section (e.g., b)) formed by a planar area of the display area of the flexible display **330**, which is inserted into the housing **310** as a deactivation area.

In an embodiment, the electronic device **801** may determine the area **1520** excluding deactivation areas **1530**, **1540**, and **1550** of the flexible display **330** as an activation area.

FIG. **16**A is a view **1600** illustrating a semicircular conductor **1610** disposed in an inner space of a housing **310** of an electronic device **801** according to various embodiments. FIG. **16**B is a view **1630** explaining a method for applying a driving signal from a transmitter including multiple first electrode lines constituting a touch circuit **833** of a flexible display **430** according to various embodiments. FIG. **16**C is a view **1660** explaining a method for detecting a capacitance value based on acquisition of a driving signal through a receiver including multiple second electrode lines constituting a touch circuit **833** of a flexible display **430** according to various embodiments.

Referring to FIG. **16**A, at least a portion of the flexible display **430** (e.g., the flexible display **430** in FIG. **3**A and FIG. **3**B) of the electronic device (e.g., the electronic device **801** in FIG. **8**) may be inserted into the inner space of the housing **410** (e.g., the housing **410** in FIG. **4**A and FIG. **4**B), and at least another portion of the flexible display **430** may be in a state of being withdrawn to the outside of the housing **410**.

In an embodiment, the electronic device **801** may further include a semicircular conductor **1610** disposed in the inner space of the housing **410**.

In an embodiment of FIG. **16**A according to various embodiments, compared to the embodiment of FIG. **13**A, as the semicircular conductor **1610** is disposed in the inner space of the housing **410**, a capacitance value with respect to the display area of the flexible display **430** corresponding to a curved bending area of the flexible display **430** in FIG. **16**A may be different from a capacitance value with respect to the display area **1320** of the flexible display **430** corresponding to a curved bending area of the flexible display **430** in FIG. **13**A.

For example, referring to FIG. **16**B, as the flexible display **430** is inserted into the inner space of the housing **410**, an area **1640** including the first section (e.g., a) to the second section (e.g., b) of the display area of the flexible display **430** may be disposed in the inner space of the housing **410**. For example, a partial area **1640** (e.g., an area including the first section (e.g., a) to a second section (e.g., b)) of the first section (e.g., a) to the third section (e.g., c) of the display area may be inserted into the inner space of the housing **410** and areas **1643** and **1645** excluding the area **1640** including the first section (e.g., a) to the second section (e.g., b) may be formed as a planar area.

In an embodiment, as the electronic device **801** further includes the semicircular conductor **1610** in the inner space of the housing **410**, a driving signal **1620** may be applied through the transmitter **410** of the flexible display **330** and a driving signal **1625** may be applied through the semicircular conductor **1610**.

In an embodiment, the driving signals **1620** and **1625** applied through the transmitter **410** of the flexible display **330** and the semicircular conductor **1610** may be acquired through a receiver (e.g., the receiver **420** in FIG. **4**A) (e.g., the multiple second electrode lines) of the flexible display **430**. The electronic device **301** may identify a capacitance value based on a driving signal to be acquired.

In FIG. **16**C according to various embodiments, the x-axis indicates an area **1165** of the unfolded flexible display **430** and the y-axis shows a capacitance value **1670** of the flexible display **430**.

Referring to FIG. **16**C, a difference between a second capacitance value **1685** of the area **1640** including the first section (e.g., a) to the second section (e.g., b) and a first capacitance value **1680** of the areas **1643** and **1645** excluding the area **1640** including the first section (e.g., a) to the second section (e.g., b) in a structure including the semicircular conductor **1610** according to the embodiment of FIG. **16**A may be relatively larger than a difference between the second capacitance value **1380** of the area **1320** including the first section (e.g., a) to the second section (e.g., b) and the first capacitance value **1385** of the areas **1330** and **1340** excluding the area **1320** including the first section (e.g., a) to the second section (e.g., b) in a structure not including the semicircular conductor **1610** according to the embodiment of FIG. **13**A.

In FIG. **16**A according to various embodiments, as a driving signal **1620** is applied from the transmitter **510** (e.g., the multiple first electrode lines) in an outward direction (e.g., direction ②) of the flexible display **430** and a driving signal **1625** is applied through the semicircular conductor **1610**, the first capacitance value **1680** of the area **1640** including the first section (e.g., a) to the second section (e.g., b) may have a relatively large difference from the second capacitance value **1685** with respect the display area **1643** or **1645** of the flexible display **430** corresponding to the planar area.

In an embodiment, the electronic device **801** may determine the area **1640** including the first section (e.g., a) to the second section (e.g., b) of the flexible display **430** having the first capacitance value **1680** different from the second capacitance value **1685** as a bending area, for example, a folded area. Based on the area **1640** including the first section (e.g., a) to the second section (e.g., b) of the flexible display **430**, which is determined as the folded area, a deactivation area may be determined. The electronic device **801** may determine an area **1630** excluding the deactivation area with respect to the folded area of the flexible display **430** as an activation area.

In various embodiments, the electronic device **801** may determine, as an activation area, an area exposed to the outside of the electronic device **801**, for example, a second curved portion (e.g., the second curved portion **430***c* in FIG. **4**A) of the area determined as the bending area of the flexible display **430**.

In various embodiments, the electronic device **801** may further determine an area **1645** formed by the planar area of the display area of the flexible display **430**, which is inserted into the housing **410**, as a deactivation area.

FIG. **17** is a view **1700** explaining a method for determining an activation area of a flexible display **430** according to various embodiments.

Referring to FIG. **17**, according to the embodiment of FIG. **16**A to FIG. **16**C described above, an electronic device (e.g., the electronic device **801** in FIG. **8**) may determine an area **1720** including the first section (e.g., a) to the second section (e.g., b) of the whole display area of the flexible display **430** (e.g., the flexible display **430** in FIG. **4**A and FIG. **4**B) as a folded area.

For example, as shown in FIG. **16**A to FIG. **16**C described above, the electronic device **801** may determine the area **1720** including the first section (e.g., a) to the second section (e.g., b) as a folded area, based on a capacitance value detected from the area **1720** (e.g., **1640** in FIG. **16**C) including the first section (e.g., a) to the second section (e.g., b). In an embodiment, the electronic device **801** may further determine an area **1710** formed by the planar area of the display area of the flexible display **430**, which is inserted into the housing **410**, as a deactivation area. By way of example, the area **1710** inserted into the housing **410** may be determined based on a configuration value (e.g., a specified distance value from one end of the folded area) stored in a memory (e.g., the memory **130** in FIG. **1**) of the electronic device **801** and/or a state (e.g., an intermediate state) of the electronic device **801** detected through a sensor (e.g., a Hall sensor).

In various embodiments, configuration of the deactivation area may correspond to turning off a display of a partial area **1710** or **1720** of the flexible display **430** or ignoring touch coordinates occurring in the partial area **1710** or **1720** of the flexible display **430** so as to prevent malfunction of a touch input, which may occur in the deactivated area **1710** or **1720**.

In an embodiment, the electronic device **801** may determine, as an activation area, the area **1740** of the flexible display **430** excluding the area **1710** or **1720** having been determined as the deactivation area.

FIG. **18**A and FIG. **18**B views **1800** and **1850** explaining a method for changing an activation area of a flexible display **330** based on detection of a state change of the flexible display **330** according to various embodiments.

Referring to FIG. **18**A, an electronic device (e.g., the electronic device **801** in FIG. **8**) may detect a state change in which a flexible display (e.g., the flexible display **330** in FIG. **3**A and FIG. **3**B) is withdrawn **1805** to an outer space of a housing (e.g., the housing **310** in FIG. **3**A and FIG. **3**B). Without limitation thereto, although not shown, the state change may include a state change in which the flexible display **330** is inserted into an inner space of the housing **310**.

In an embodiment, based on detecting of the state change in which the flexible display **330** is withdrawn **1805** to the outer space of the housing **310**, a predetermined folded area of the flexible display **330** may be changed. For example, in case that the flexible display **330** is withdrawn **1805** to the outer space of the housing **310**, a folded area of the flexible display **330** may be changed as well. For example, based on detecting of the state change in which the flexible display **330** is withdrawn from the inner space of the housing **310**, the electronic device **301** may acquire, through the receiver **420**, a driving signal which has been applied through the transmitter **410** constituting a touch circuit (e.g., the touch panel **833** in FIG. **8**) included in the flexible display **330**. The electronic device **301** may identify a capacitance value based on the capacitance value to be acquired and determine a folded area (e.g., a bending area) of the flexible display **330**.

In FIG. **18**B according to an embodiment, the x-axis indicates an area **160** of the unfolded flexible display **330** and the y-axis shows a capacitance value **1870** of the unfolded flexible display **330**.

Referring to FIG. **18**B, before detecting the state change in which the flexible display **330** is withdrawn **1805** to the outer space of the housing **310**, a capacitance value of an area **1820** including the second section (e.g., b) and the third section (e.g., c) of the flexible display **330** is a second capacitance value **1893** which may be different from a first capacitance value **1891** of an activation area **1830** of the flexible display **330** and an area **1810** which is inserted into an inner space of the electronic device **801** but does not form a curved surface.

In an embodiment, based on detecting of the state change in which the flexible display **330** is withdrawn **1805** to the outer space of the housing **310**, an area **1890** including the second section (e.g., b') and the third section (e.g., c) of the flexible display **330** may have a second capacitance value **1893** and based thereon, the electronic device **801** may determine the **1890** including the second section (e.g., b') and the third section (e.g., c) of the flexible display **330** having the second capacitance value **1893** as a folded area.

In an embodiment, the electronic device **801** may configure the area **1890** including the second section (e.g., b') and the third section (e.g., c) of the flexible display **330**, which has been determined as the folded area, as a deactivation area. In an embodiment, an area **1885** inserted into the housing **310** to be formed to be the planar area of the display area of the flexible display **330** may be further configured as a deactivation area.

In an embodiment, as the folded area of the flexible display **330** is changed, the activation area of the flexible display **430** may be changed as well. For example, based on detecting of the state change in which the flexible display **330** is withdrawn **1805** to the outer space of the housing **310**, the activation area **1830** of the flexible display **430** may be changed into an area **1883**.

FIG. **19** a view **1900** explaining a method for changing an activation area of a flexible display **330** based on detection of a state change of the flexible display **330** according to various embodiments.

Referring to FIG. **19**, in a state in which an area including the second section (e.g., b) and the third section (e.g., c) of the whole display area of the flexible display **330** (e.g., the flexible display **330** in FIG. **3**A and FIG. **3**B) is determined as a folded area, an electronic device (e.g., the electronic device **801** in FIG. **8**) may detect a state change of the flexible display **330**. The state change may include a change to a state in which the flexible display **330** is withdrawn to the outside of the housing **310** or inserted into the inner space of the housing **310**. In case that a state change of the flexible display **330** is detected, the deactivation area and the activation area of the display area of the flexible display **330** may be changed as well.

In an embodiment, in a state in which the flexible display **330** is rolled, the electronic device **301** may determine a first area **1930** of the whole display area of the flexible display **330** as an activation area and determine a second area **1910** as a deactivation area. After determining the first area **1930** as an activation area, the electronic device **801** may determine a valid touch area as the first area **1930**.

In an embodiment, in case of detecting a state change of the flexible display **330**, the deactivation area of the flexible display **330** may be changed from the second area **1910** to a third area **1920**, and accordingly, the activation area of the flexible display **330** may be changed from the first area **1930** to a fourth area **1940**.

In various embodiments, although not shown, in case of detecting a state change of the flexible display **330**, based on that the deactivation area and the activation area of the display area of the flexible display **330** are changed, the electronic device **801** may reconfigure a screen to rearrange and/or adjust a ratio of visual information to be displayed on the flexible display **330** so as to correspond to the changed activation area. The electronic device **801** may display the screen reconfigured to correspond to the changed activation area through the activation area of the flexible display **330**.

FIG. **20**A and FIG. **20**B are views **2000** and **2050** explaining a method for changing an activation area of a flexible display **430** based on detection of a state change of the flexible display **430** according to various embodiments.

Referring to FIG. **20**A, an electronic device (e.g., the electronic device **801** in FIG. **8**) may detect a state change in which a flexible display (e.g., the flexible display **430** in FIG. **4**A and FIG. **4**B) is withdrawn **2020** to an outer space of a housing (e.g., the housing **410** in FIG. **4**A and FIG. **4**B). Without limitation thereto, although not shown, the state change may include a state change in which the flexible display **430** is inserted into an inner space of the housing **410**.

In an embodiment, based on detecting of the state change in which the flexible display **330** is withdrawn **2020** to the outer space of the housing **310**, movement of a folded area of the flexible display **430** may be detected. For example, in case that the flexible display **430** moves **1220** in a clockwise direction (e.g., the x-axis direction) (e.g., in case that the flexible display **430** is withdrawn from the inner space of the housing **410**), a bending area of the flexible display **430** may be moved (changed).

In FIG. **20**B according to an embodiment, the x-axis indicates an area **2060** of the unfolded flexible display **430** and the y-axis shows a capacitance value **2070** of the unfolded flexible display **430**.

For example, referring to FIG. **20**B, before detecting the state change in which the flexible display **430** is withdrawn **2020** to the outer space of the housing **410**, a capacitance value of an area **2080** including the first section (e.g., a) to the second section (e.g., b) of the flexible display **430** is a second capacitance value **2097** which may be different from a first capacitance value **2095** of an second area (e.g., an activation area **2083** of the flexible display **430** and a planar area **2081** inserted into the housing **410**) of the flexible display **430**. For example, the second capacitance value **2097** of the area **2080** including the first section (e.g., a) to the second section (e.g., b) of the flexible display **430** may be relatively larger than the first capacitance value **2095** of the second area (e.g., the activation area **2083** of the flexible display **430** and the planar area **2081** inserted into the housing **410**) of the flexible display **430**.

In an embodiment, based on detecting of the state change in which the flexible display **430** is withdrawn **2020** to the outer space of the housing **410**, an area **2090** including the third section (e.g., a') to the fourth section (e.g., b') of the flexible display **430** may have a second capacitance value **2097** and based thereon, the electronic device **801** may determine the **2090** including the third section (e.g., a') to the fourth section (e.g., b') of the flexible display **430** having the second capacitance value **2097** as a folded area.

In an embodiment, the electronic device **801** may configure the area **2090** including the third section (e.g., a') and the fourth section (e.g., b') of the flexible display **330**, which has been determined as the folded area, as a deactivation area. In an embodiment, an area **2091** inserted into the housing **410** to be formed to be the planar area of the display area of the flexible display **430** may be further configured as a deactivation area.

In an embodiment, as the folded area of the flexible display **330** is changed, the activation area of the flexible display **430** may be changed as well. For example, based on detecting of the state change in which the flexible display **330** is withdrawn **2020** to the outer space of the housing **310**, the activation area **2083** of the flexible display **430** may be changed into an area **2093**.

FIG. **21** is a view **2100** explaining a method for changing an activation area of a flexible display **430** based on detection of a state change of the flexible display **430** according to various embodiments.

Referring to FIG. **21**, in a state in which an area including the first section (e.g., a) and the second section (e.g., b) of the whole display area of the flexible display **430** (e.g., the flexible display **430** in FIG. **4**A and FIG. **4**B) is determined as a bending area (or a folded area), an electronic device (e.g., the electronic device **801** in FIG. **8**) may detect a state change of the flexible display **430**. The state change may include a change to a state in which the flexible display **430** is withdrawn to the outer space of the housing **410** or inserted into the inner space of the housing **410**. Based on detecting of a state change of the flexible display **430**, the bending area and the activation area of the display area of the flexible display **430** may be changed.

In an embodiment, in a state in which the flexible display **430** is folded or rolled, the electronic device **801** may determine a first area **2130** of the whole display area of the flexible display **430** as an activation area and determine a second area **2110** as a deactivation area. After the first area **2130** is determined as the activation area, in case that the bending area (e.g., an area including the first section (e.g., a) to the second section (e.g., b)) is used as a touch area, the electronic device **801** may a valid touch area as a third area **2140**. For example, in case that the electronic device **801** reproduces a multimedia content, a UX capable of performing a control operation required for multimedia content reproduction, such as play, fast forward, rewind, pause, and/or volume control, may be displayed on the bending area.

In an embodiment, in case of detecting of the state change of the flexible display **430**, the bending area of the flexible display **430** may be changed as well. For example, according to the embodiments of FIG. **20**A and FIG. **20**B, as the bending area is changed from the first section (e.g., a) to the second section (e.g., b) and from third section (e.g., a') to the fourth section (e.g., b'), the activation area of the flexible display **430** may be changed from the first area **2130** to the third area **2140** with reference to the third section (e.g., a') to the fourth section (e.g., b') and the deactivation area may be changed from the second area **2110** to a fourth area **2120**.

In various embodiments, although not shown, in case of detecting a state change of the flexible display **430**, based on that the bending area and the activation area of the display area of the flexible display **430** are changed, the electronic device **801** may reconfigure a screen to rearrange and/or adjust a ratio of visual information to be displayed on the flexible display **430** so as to correspond to the changed activation area. The electronic device **801** may display the screen reconfigured to correspond to the changed activation area through the activation area of the flexible display **430**.

In various embodiments, although not shown, in case that a rear surface of the flexible display **430** is used, the first section (e.g., a) or the third section (e.g., a') according to a state change of the flexible display **430** may function as a reference for determining the activation area of the display area on the rear surface.

The electronic device according to various embodiments may be one of various types of electronic devices. The electronic devices may include, for example, a portable communication device (e.g., a smartphone), a computer device, a portable multimedia device, a portable medical device, a camera, a wearable device, or a home appliance. According to an embodiment of the disclosure, the electronic devices are not limited to those described above.

It should be appreciated that various embodiments of the disclosure and the terms used therein are not intended to limit the technological features set forth herein to particular embodiments and include various changes, equivalents, or replacements for a corresponding embodiment. With regard to the description of the drawings, similar reference numerals may be used to refer to similar or related elements. It is to be understood that a singular form of a noun corresponding to an item may include one or more of the things, unless the relevant context clearly indicates otherwise. As used herein, each of such phrases as "A or B," "at least one of A and B," "at least one of A or B," "A, B, or C," "at least one of A, B, and C," and "at least one of A, B, or C," may include any one of, or all possible combinations of the items enumerated together in a corresponding one of the phrases. As used herein, such terms as "1st" and "2nd," or "first" and "second" may be used to simply distinguish a corresponding component from another, and does not limit the components in other aspect (e.g., importance or order). It is to be understood that if an element (e.g., a first element) is referred to, with or without the term "operatively" or "communicatively," as "coupled with," "coupled to," "connected with," or "connected to" another element (e.g., a second element), it means that the element may be coupled with the other element directly (e.g., through wires), wirelessly, or via a third element.

As used in connection with various embodiments of the disclosure, the term "module" may include a unit implemented in hardware, software, or firmware, and may interchangeably be used with other terms, for example, "logic," "logic block," "part," or "circuitry." A module may be a single integral component, or a minimum unit or part thereof, adapted to perform one or more functions. For example, according to an embodiment, the module may be implemented in a form of an application-specific integrated circuit (ASIC).

Various embodiments as set forth herein may be implemented as software (e.g., the program **140**) including one or more instructions that are stored in a storage medium (e.g., internal memory **136** or external memory **138**) that is readable by a machine (e.g., the electronic device **101**). For example, a processor (e.g., the processor **120**) of the machine (e.g., the electronic device **101**) may invoke at least one of the one or more instructions stored in the storage medium, and execute it, with or without using one or more other components under the control of the processor. This allows the machine to be operated to perform at least one function according to the at least one instruction invoked. The one or more instructions may include a code generated by a complier or a code executable by an interpreter. The machine-readable storage medium may be provided in the form of a non-transitory storage medium. Wherein, the term "non-transitory" simply means that the storage medium is a tangible device, and does not include a signal (e.g., an electromagnetic wave), but this term does not differentiate between where data is semi-permanently stored in the storage medium and where the data is temporarily stored in the storage medium.

According to an embodiment, a method according to various embodiments of the disclosure may be included and provided in a computer program product. The computer program product may be traded as a product between a seller and a buyer. The computer program product may be distributed in the form of a machine-readable storage medium (e.g., compact disc read only memory (CD-ROM)), or be distributed (e.g., downloaded or uploaded) online via an application store (e.g., PlayStore™), or between two user devices (e.g., smart phones) directly. If distributed online, at least part of the computer program product may be temporarily generated or at least temporarily stored in the machine-readable storage medium, such as memory of the manufacturer's server, a server of the application store, or a relay server.

According to various embodiments, each component (e.g., a module or a program) of the above-described components may include a single entity or multiple entities, and some of the multiple entities may be separately disposed in different components. According to various embodiments, one or more of the above-described components may be omitted, or one or more other components may be added. Alternatively or additionally, a plurality of components (e.g., modules or programs) may be integrated into a single component. In such a case, according to various embodiments, the integrated component may still perform one or more functions of each of the plurality of components in the same or similar manner as they are performed by a corresponding one of the plurality of components before the integration. According to various embodiments, operations performed by the module, the program, or another component may be carried out sequentially, in parallel, repeatedly, or heuristically, or one or more of the operations may be executed in a different order or omitted, or one or more other operations may be added.

What is claimed is:

1. An electronic device comprising:
- a housing;
- a touch circuit comprising multiple TX electrodes and multiple RX electrodes, wherein the multiple RX electrodes are arranged to cross over the multiple TX electrodes;
- a flexible display comprising the touch circuit, the flexible display being movable out from an inner space of the housing;
- a touch controller; and
- a processor operatively connected to the touch circuit, the flexible display, and the touch controller,
- wherein the touch controller is configured to:
  - apply a driving signal through the multiple TX electrodes of the touch circuit;
  - acquire the driving signal through the multiple RX electrodes;
  - identify a capacitance value based on the acquired driving signal; and

identify information about a folded area of the flexible display based on the capacitance value, and

wherein the processor is configured to:

based on the information about the folded area of the flexible display, determine an activation area with respect to an unfolded area of the flexible display;

determine an area of the display area of the flexible display, which is inserted into the inner space of the housing and formed to be a planar area, as a deactivation area;

detect movement of the folded area based on the capacitance value;

adjust the activation area based on the detected movement of the folded area;

adjust a ratio of a screen including visual information to be displayed on an adjusted activation area and reconfigure the screen including the visual information based on the adjusted activation area; and

output the reconfigured screen through the adjusted activation area.

2. The electronic device of claim **1**, wherein the processor is further configured to determine an area of the display area of the flexible display excluding the folded area and the area inserted into the inner space of the housing and formed to be a planar area, as the unfolded area.

3. The electronic device of claim **1**, wherein the touch controller is further configured to:

identify whether a state change of the flexible display is detected after the activation area with respect to the unfolded area of the flexible display is determined; and

identify the capacitance value based on the driving signal acquired through the multiple RX electrodes as applied through the multiple TX electrodes, wherein the change in driving signal is based on the detection of the state change of the flexible display.

4. The electronic device of claim **1**, wherein the touch controller is further configured to identify the capacitance value based on the driving signal acquired through the multiple RX electrodes as applied through the multiple TX electrodes at a designated time interval after the activation area with respect to the unfolded area of the flexible display is determined.

5. The electronic device of claim **1**, further comprising a semicircular conductor disposed in the inner space of the housing.

6. The electronic device of claim **5**, wherein the touch controller is further configured to apply the driving signal by using the semicircular conductor based on the detection of a state change of the flexible display.

7. The electronic device of claim **1**, wherein the state change of the flexible display comprises a change into a state in which the flexible display is withdrawn from the inner space of the housing of the electronic device or inserted into the inner space of the housing.

8. A method for display of an electronic device comprising a flexible display, the method comprising:

applying a driving signal by using multiple TX electrodes of a touch circuit included in the flexible display;

acquiring the driving signal through multiple RX electrodes of the touch circuit;

identifying a capacitance value based on the acquired driving signal;

identifying information about a folded area of the flexible display based on the capacitance value;

determining, based on the information about the folded area of the flexible display, an activation area with respect to an unfolded area of the flexible display;

determining an area of the display area of the flexible display, which is inserted into the inner space of a housing of the electronic device and formed to be a planar area, as a deactivation area;

detecting movement of the folded area based on the capacitance value;

adjusting the activation area based on the detected movement of the folded area;

adjusting a ratio of a screen including visual information to be displayed on an adjusted activation area and reconfigure the screen including the visual information based on the adjusted activation area; and

outputting a reconfigured screen through the adjusted activation area.

9. The method of claim **8**, wherein the determining of the activation area with respect to the unfolded area of the flexible display comprises:

determining an area of the display area of the flexible display excluding the folded area and the area inserted into the inner space of the housing and formed to be a planar area, as the unfolded area.

10. The method of claim **8**, further comprising:

identifying whether a state change of the flexible display is detected after the activation area with respect to the unfolded area of the flexible display is determined; and

identifying the capacitance value based on the driving signal acquired through the multiple RX electrodes as applied through the multiple TX electrodes, wherein the change in driving signal is based on the detection of the state change of the flexible display.

11. The method of claim **8**, further comprising:

identifying the capacitance value based on the driving signal acquired through the multiple RX electrodes as applied through the multiple TX electrodes at a designated time interval after the activation area with respect to the unfolded area of the flexible display is determined.

12. The method of claim **11**, further comprising:

detecting movement of the folded area based on the capacitance value; and

adjusting the activation area based on the detected movement of the folded area.

13. The method of claim **8**, wherein the electronic device comprises a semicircular conductor disposed in an inner space of a housing of the electronic device.

14. The method of claim **13**, further comprising: applying the driving signal by using the semicircular conductor based on detection of a state change of the flexible display.

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